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MAGAZINE

NOVEMBER 13, 1990

THE INDEPENDENT GUIDE TO PERSONAL COMPUTING

VOLUME 9 NUMBER 19

PC Labs
Tests

121 PRINTERS

PLUS

For the LaserJet
You Own:
11 Postscript
Add-ons

FREE UTILITY

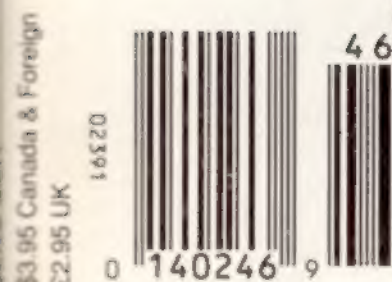
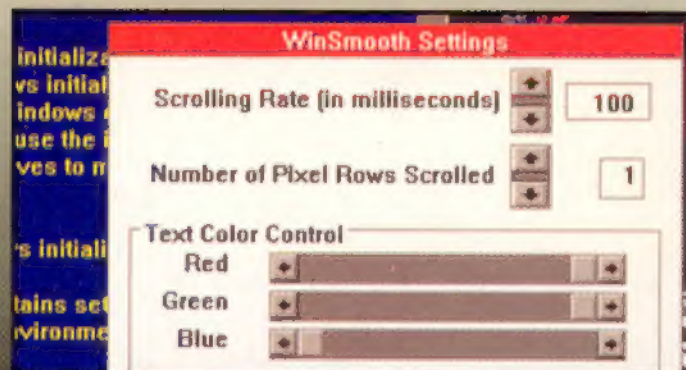
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Scroll them Smoothly
With WSMOOTH**

AFTER HOURS

**Musical Magic
On a Budget:
Four New MIDI
Products**

LAB NOTES

**Power Trip: A Tour
Of the Inner
Workings of Intel's
486 Chip**



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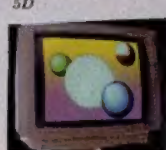
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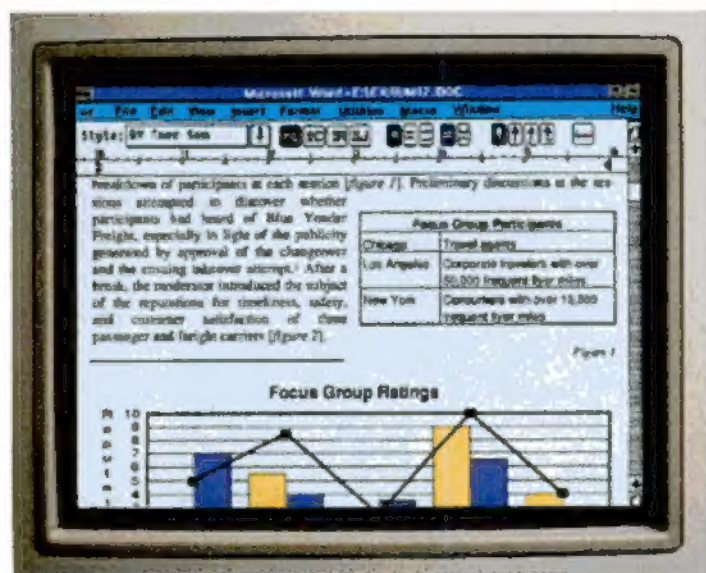


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Board*



NEC

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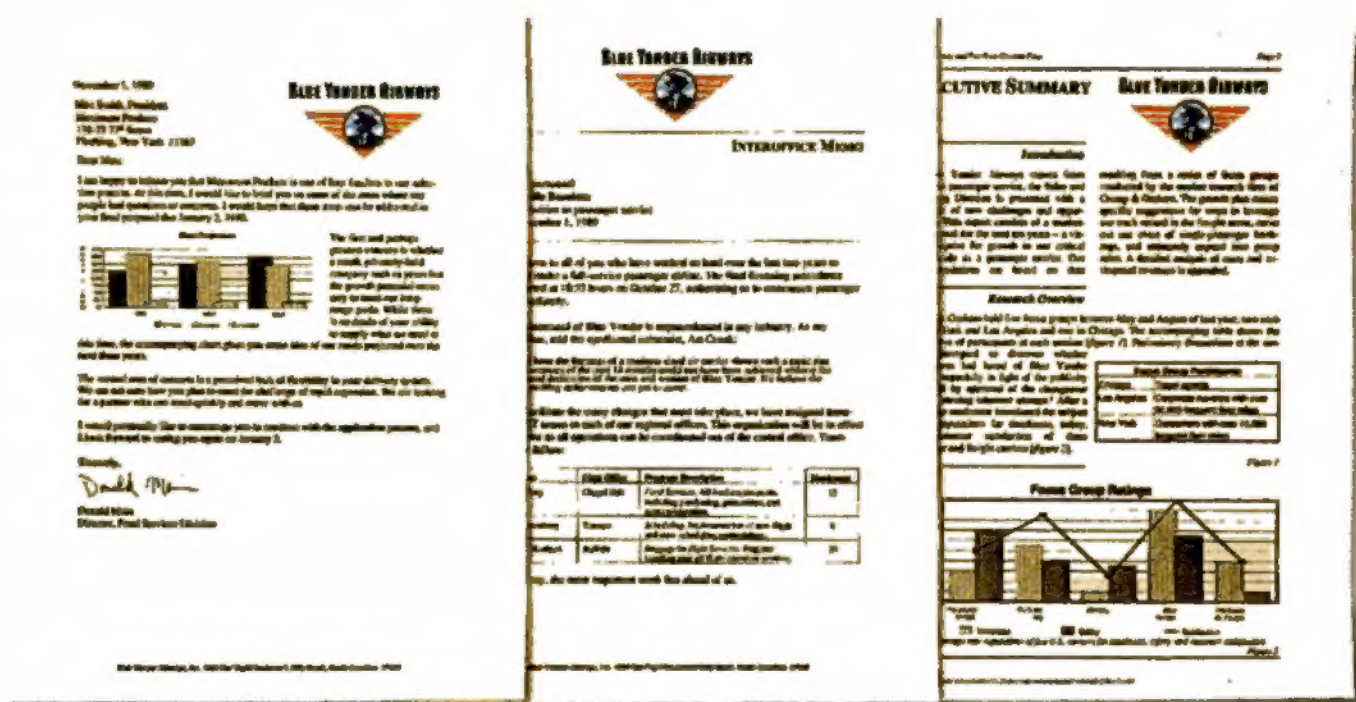


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CIRCLE 359 ON READER SERVICE CARD

Inside



Venerable veterans of the printer project (clockwise from upper left): David Stone, Bill O'Brien, Thom O'Connor, Al Poor, Bruce Brown, Karen Carter, Diane D'Angelo, and Mary Flynn.

Like all great campaigns, the ongoing *PC Magazine* printer project boasts an impressive group of veterans.

Three of this year's contributors were there when editor-in-chief Bill Machrone started it all seven years and 700-plus printers ago. Since 1984, contributing editor Alfred Poor has reviewed more than 80 printers, including the original Hewlett-Packard LaserJet. In his spare time, Poor founded the Printer Project Survivors' Support Group (PPSSG), which provides morale-boosting posters, poetry, and puns to the troops.

Contributing editor M. David Stone, also a seven-year survivor, has approximately 100 printer reviews to his credit. Stone penned the introduction to this issue's laser printer section.

Executive editor Bill Howard also participated in the first printer issue. As he has for two previous printer blockbusters, Howard wrote this issue's main introduction.

Since contributing editor Bill O'Brien came on board the printer project in 1985, he's written and re-

written just about every line of code in our 30MB group of tests. Author of six books, O'Brien churned out eight printer reviews for this issue.

With 105 reviews to his name, contributing editor Bruce Brown holds the PPSSG record. Equally impressive is the whopping 500 printers shot by Thomas O'Connor, the magazine's principal photographer. Both joined up in 1986, as did managing editor (and drill sergeant) Diane D'Angelo, who made sure this issue was produced on time and in top form.

At the front lines, PC Labs project leader Robert W. Kane supervised the testing of all 121 printers reviewed in this issue—our biggest ever. Kane has been with the magazine since 1987, the same year Karen A. Carter, manager of copy edit, was recruited. Having joined up in 1988, I hold the dubious distinction of being the only associate editor to put out two printer issues.

Armed with such a distinguished corps of experts, you're guaranteed to find a printer that's right for you.—Mary Kathleen Flynn ■

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†Patent Pending

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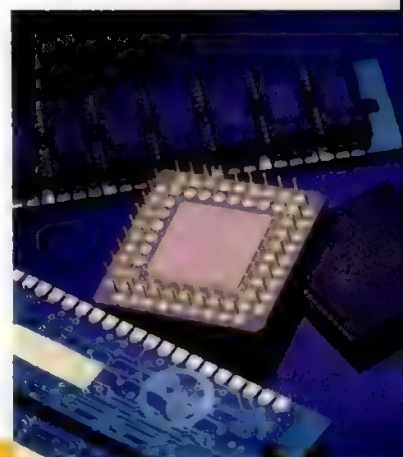
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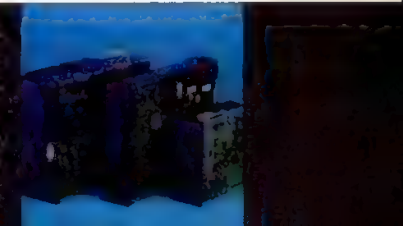
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HIGHLIGHTS

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AUSTIN 486/25 WINSTATION

STANDARD FEATURES

- 8 32-bit EISA/ISA Compatible Slots
- 6 Slots available for Bus Masters
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- Shadow RAM Caching (BIOS/Video)
- Dual Floppy/IDE Hard Drive Controller—1:1 Interleaving
- Floppy Drive (1.44Mb or 1.2Mb)
- 1 Parallel and 2 Serial Ports
- Enhanced 101 Keyboard with Tactile/Click Touch
- Real-Time Clock with Battery Backup
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HIGHLIGHTS

- 80286 16MHz Microprocessor
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- VGA Monochrome Monitor with VGA Video Adapter
- Complete System for only \$1290.

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AUSTIN 286/16

STANDARD FEATURES

- Dual Floppy/IDE Hard Drive Controller—1:1 Interleaving
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HIGHLIGHTS

- 80386SX Intel 16MHz Microprocessor
- 2Mb RAM (expands to 8Mb on board)
- 40Mb IDE Hard Drive
- 14" Austin High Clarity VGA Color Monitor
- Super-Charged VGA Video Adapter (Supports up to 1Mb VRAM)
- Pre-Loaded with Microsoft Windows 3.0 and MS-DOS 4.01
- Microsoft Mouse
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AUSTIN 386/SX16 WINSTATION

STANDARD FEATURES

- Floppy Drive (1.44Mb or 1.2Mb)
- Dual Floppy/IDE Hard Drive Controller—1:1 Interleaving
- 7 Expansion Slots (1 8-bit and 6 16-bit)
- 80387/SX Math Coprocessor Socket
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STANDARD FEATURES

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- Dual Floppy/IDE Hard Drive Controller—1:1 Interleaving
- 7 Expansion Slots (1 8-bit and 6 16-bit)
- 80387/SX Math Coprocessor Socket
- 1 Parallel and 2 Serial Ports
- Enhanced 101 Keyboard with Tactile/Click Touch
- Real-Time Clock with Battery Backup
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HIGHLIGHTS

- 80386SX Intel 20MHz Microprocessor
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- 14" Austin High Clarity VGA Color Monitor
- Super-charged VGA Video Adapter (Supports up to 1Mb VRAM)
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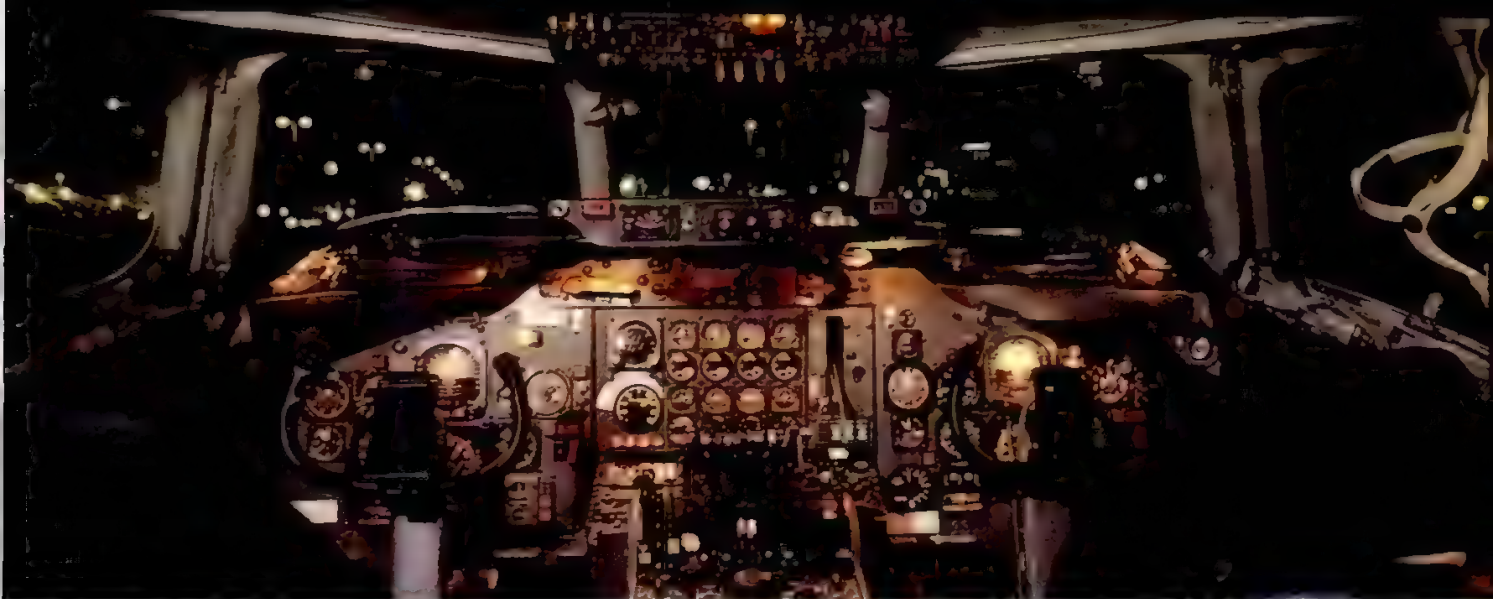
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But for that you need Windows or OS/2. Which means you also need to learn enough to get a pilot's license. And spend enough on hardware and software for a down payment on a jet.

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Software Carousel got to be a best-seller because it works. Simply and reliably. Day in and day out.

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Best of all, nearly any program that now runs on your PC will work with Software Carousel. Even RAM resident utilities, graphics programs and network software. And Software Carousel works

on all types of PCs. So you can have the kind of multi-application capability you want, without buying anything new.

Now with Print'N'Run.

Thanks to Print'N'Run, new Software Carousel is also an advanced print handler. One that quickly takes over your printing jobs by accepting all the output bound for the printer, then sending it to the printer as fast as it can take it.

While your printer keeps running, you can keep working in the same application. Or switch to another Software Carousel work area running a different application.

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OLE is the optional Open Link Extender* for Software Carousel. And it could be the best thing to happen to networks since OS/2 itself.

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And OLE works with all kinds of connection software. Including IBM, Attachmate, and others. Without changes to your hardware or software.

Even the experts agree.

Garry Ray, writing for PC Week, said, “Of these alternative operating environments (OS/2, DesqView and Software Carousel), Carousel may be the best choice of the day.”

Barry Simon of PC Magazine concurred with, “...I find it difficult to imagine using my computer without Carousel.

This package has become an essential tool and one that I strongly recommend.”

So if you really want the major benefits of Windows and OS/2, don't get grounded with high cost and mind-bending complexity. Take off today with

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Software Carousel \$89⁹⁵

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Letters

THUMBS DOWN ON THE PS/1

I had to write regarding your PS/1 review (First Looks, August 1990). Having been "burned" by buying the PCjr and trying to productively use IBM's early line of software duds (Business Solutions and Productivity Series, *TopView*, *DisplayWrite*, and so on) I have no confidence in IBM or its corporate judgment concerning desktop computers. The PS/1 is too little, too late for anyone's Christmas stocking.

As far as IBM's market survey goes, "Statistics don't lie, but statisticians do."

Tom Takesian

Annapolis, Maryland

Re the PS/1 review in your August issue: IBM is *right* about people wanting to buy computers where they already shop. IBM is *also* right about preinstalling so that people can simply take it home, plug it in, and turn it on. They will definitely sell "some" number of these PS/1s.

Your front cover asks if I would buy a PS/1? No! Nor will I recommend one. Computer stores in my area have Saturday hours, and while the dealer may not know more than the salespeople at Sears, at least he won't be pulled away to fill in for the TV clerk in the next department. The dealers to which I send people already format and install systems and show customers which cable goes where.

Some people will buy a PS/1 and be happy. Others will realize that they can buy a clone for less money that will do more *and* be easier and cheaper to expand.

Tom Smith

Portland, Oregon

That was some review on the PS/1! IBM has got to have the most outstanding marketing force in the universe. No one else would have the hair to repackage the 80286 chip—and a 10 MHz at that! What's next? A 4.77-MHz 8086-based machine called the PS/0.5?

Hugh Doctorman

Oklahoma City, Oklahoma



Based on Gus Venditto's apology for reviewing the IBM PS/1 and Tony Rizzo's defense of *Microsoft Windows*, (August 1990), I shouldn't even be reading *PC Magazine*, let alone be writing to you. With 640K and an 80286, my Tandy 1000SX is a chuckle to you big guys, right? If I don't run *Windows 3.0* on a 386, you guys think that I should get lost.

Okay, I'll go. But I'll never understand why you want IBMs and compatibles to run more like Macs. DOS machines have always outsold Macs; why copy what they're beating every day? Even if *Windows 3.0* is the improvement you claim, its hardware requirements, like the Mac's, are ridiculous. If your real tasks don't require the power of a 386 or 486 chip, why buy one just to use a fancy interface? Why purchase software that requires monster processors and megamemory just to deliver the speed of ordinary DOS programs on an AT or even an XT?

Readers clever enough to use your tips and utilities are the last people in the world to need GUI protection from a C: prompt.

William C. Ramsey

Proctorville, Ohio



For different views on the PS/1, see Jim Seymour and John C. Dvorak's reviews in our October 30, 1990, issue—Ed.

A WINDOWS WASH

I wish to thank you for your spirited defense of *Windows 3.0* in the Letters column of your August issue. I am *glad* to see the new *Windows* section. One of the best things about *Windows* is how it extends the use of the 286. I have been a bit put off by many reviewers who keep insisting that one needs a 386SX minimum to run *Windows* well. That is not true. *Windows 3.0* runs beautifully on a 12-MHz 286.

Instead of focusing on the CPU, the reviewers should stress memory instead: 286 users will not be satisfied without at least 2MB of extended memory, and 3MB is better.

Don't get me wrong. I am not endorsing the purchase of new 286s. The next PC I buy will be a 386 or better, but *Windows 3.0* allows users to get another year or two of satisfaction out of their present equipment before they upgrade.

Stephen Conklan

Centreville, Alabama

Okay! Okay! I believe! 386s and *Windows 3.0* into the future. So tell me how to convert my AT clones to SXs now, or at least whisper into my ear who is going to make a 286-to-386 compatible chip and when. Or else explain to me why no one is. Is there a conspiracy against us dummies who bought the last ATs?

Cecil Truluck

New York, New York



Your best bet really is to buy new PCs and sell your ATs (one option is via the Boston Computer Exchange) or donate them to charity and get a tax deduction. If this isn't possible, you can purchase an accelerator card, like the Cumulus 80386SX card or Intel's Inboard 386/PC; they both plug into the 80286

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Letters

socket. Orchid Technology also makes a plug-in upgrade solution called the Jet 386. You can also replace the PC's motherboard with an 80386-based one, but that's not as cost effective as getting an accelerator card.—Ed.

Your reply to L. Blume's derisive description of *Windows* was telling. Now anyone can see what the benefits of *Windows* 3.0 will be in the coming year:

Windows 3.0 will be analyzed and otherwise mentioned incessantly in *PC Magazine* and in other trade magazines for obvious reasons.

PC Magazine's ad revenues from software developers for *Windows* applications will swell.

Millions of middle managers will pass the time playing solitaire when they've got nothing else to do.

Will those who are entranced by the pretty face of *Windows* spend thousands of dollars for *Windows* applications in order to point, click, and drag themselves through the long months until the dawning of the OS/2 Age? Perhaps. But as for me, I think I'll just wait for OS/3. Or OS/4 . . .

John Knox
San Francisco, California

SOFTWARE AND OTHER COSTLY DISASTERS

Regarding Bill Machrone's July 1990 editorial ("Software Up in Flames") about replacing software:

Maybe Bill should call Ford or GM and see what discounts he can get for a replacement automobile. I am in the LAN hardware business and have never considered offering cheap replacement Ethernet cards for disaster victims. Does that make me so medieval?

No matter what you think of the production costs of the merchandise, computer software is a manufactured product and you shouldn't be too surprised if the manufacturers themselves see it that way. In fact, I was pretty surprised by the very liberal replacement policies you cited: less broad-minded vendors are simply maintaining the status quo.

Mitch Barrie
Santa Ana, California

When Bill Machrone stated that Lotus "[comes] through for users," it seems he

didn't add up their replacement fees. At \$25 per disk, \$5 for a template, \$45 for a set of manuals, and \$10 for a binder, I would have to pay \$210 to replace 1-2-3. The street price is about \$300, so purchasing a replacement copy would admittedly save me \$90, but would hardly be worth the bother of providing Lotus with proof of the loss and waiting for whatever

Will those entranced by
Windows' pretty face
spend thousands for
Windows applications
to point, click, and drag
themselves through the
long months until the
dawning of the OS/2
Age? Perhaps.

length of time it would take for them to determine that I wasn't trying to rip them off. Machrone's analysis of the wide inconsistency among software publishers is right on the money, however, and I hope those who formulate policy will take notice.

Medora Van Denburgh
Berwick, Maine

WHERE'S YOUR CAPS LOCK KEY?

In John C. Dvorak's August Inside Track column, he asserts that IBM adopted the "dumb layout" of putting the Caps Lock key next to the A "a few years ago." This has been the standard layout for typewriter keyboards for the better part of this century.

Secretaries, who do the vast majority of word processing for businesses, and trained typists are used to—and expect—this layout, unlike the Johnny-come-lately computer press who have the arrogance to claim this layout is not the one "God intended."

Louis Michael Bell
Chicago, Illinois

Keyboard manufacturers talk a lot about ergonomically designed keys, but they

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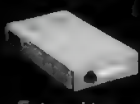


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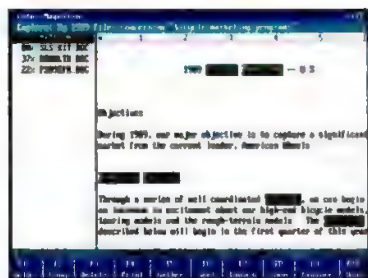
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Letters

always overlook the position of the Caps Lock LED. The only way I notice if the Caps Lock is on is when I type a few letters or words and then I look at the screen and I see they accidentally came out all in caps. Why not place the Caps Lock LED in the G or H key (or above the 5 or 6 key), or some place where your eyes normally are when typing?

Peter Runge
Cotia, Brazil



Many software packages give you an on-screen indication that your Caps Lock is on.—Ed.



CLAIRVOYANCE AND RELIABILITY

Product support—that is, repair service and technical information—is at least as important as product quality. Has *PC Magazine* looked into the possibility of rating manufacturers with regard to product support?

Phillip Sollins
Corvallis, Oregon



Funny you should ask. As your letter came in, our "Service and Reliability Blockbuster" was going out. If you missed it, it's in our September 25, 1990, issue.—Ed.



CULTURE SHOCK

I could hardly believe seeing a "Seymour-basher" letter in your July Letters column, with no one coming to his defense. I, too, was a little surprised when I saw Seymour's claim (March 27, 1990) that the Japanese thought they were smarter than anyone else: surprised that the Americans knew what goes on over here. The timing was right; it was just after the local Japanese press reported a survey showing that 80 percent of the Japanese believe that they are the most intelligent race on earth, and that the Japanese work harder than anyone else. I've yet to meet a long-term resident foreigner who finds either of those suggestions anything but preposterous.

Perhaps the Seymour-basher was right that we shouldn't tar the other 20 percent with the same brush, but blame the trade deficit on Jim for this verifiable statement? Come on! Try closed markets with the highest prices in the world! You can't buy American products over here, or get them

served, either. When Americans have superior products they're locked out: it would disrupt the local market.

Rafael Suarez
Chiba City, Japan

MORE OF THE BEST

When my office got computerized several years ago, I was supposed to find out how things worked. By spending some 40 minutes reading your best-utilities article ("The Ultimate Utility Shelf," June 26, 1990), I learned more about great programs than I have during two years of trial and error.

Hermrod Pedersen
Malmo, Sweden

MORE SOFTWARE SLOP

John Dvorak often drives me crazy, and I've written more than one letter taking him to task. But sometimes he hits the nail right on the head. His June 12 column ("The Software Slop Factor") is absolutely correct. It ought to be required reading for every software company executive.

I'm convinced that the true functionality of many programs flattens out—perhaps even declines—as they grow too feature-rich. That's not to say new features shouldn't be added; it is to say that maybe taking more time to elegantly integrate them and condense code would be a good idea.

Sadly, I think this industry is driven in large part by feature nuts and "tweaks"—folks who have far more fun playing with their computer than working on it.

Roger Keeling
Berkeley, California

CORRECTIONS & AMPLIFICATIONS

In the article "Multiuser Graphics Terminals," (August 1990) it was incorrectly stated that Viewport Technology is a subsidiary of IGC. According to IGC, Viewport Technology is not and has never been a subsidiary.

HOW TO WRITE TO PC MAGAZINE

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by
Gus Venditto

Advisor

LENGTHENING LAPTOP BATTERY LIFE

The amount of work I can get from my Toshiba T1000 laptop is unpredictable. The battery life seems to be getting shorter. Does this mean I need to replace the battery?

John Davis
Yonkers, New York

 Probably not. The rechargeable nickel cadmium batteries used in the T1000 and most laptops develop a "memory" for the amount of charging they'll store; if you're not completely discharging the battery before starting a recharge, the battery will gradually develop a shorter recharge cycle.

As often as possible you should practice "deep discharging," letting the laptop run until the battery is completely spent. To correct the built-up memory in the battery now, do a deep discharge, fully charge the system, and then repeat the process.

If your work habits make it impossible to practice deep discharging on a regular basis you probably ought to get a second battery that you can keep fully charged as a spare.

To help you better manage the battery life of your laptop, consider the program *Battery Watch* from Traveling Software (Bothell, Wash.; (206) 483-8088; \$39.95). It will give you a general idea of how much life is left in your charge, though it will only work properly when the battery's memory is fully charged and freed of bad memories.

POSTSCRIPT PRINTING WITH CLIPPER

My office develops database applications using *Clipper*. Many clients have selected TI's Omnilaser 2115—a PostScript device—as their standard printer. Since it can emulate the HP LaserJet, our applications can print in that mode, but our clients naturally wish to take advantage of the TI's PostScript capabilities. Are

■ **LENGTHENING LAPTOP BATTERY LIFE:**
How to get the most from your portable's cells.

■ **POSTSCRIPT PRINTING WITH CLIPPER:**
The roundabout way to use TI's Omnilaser with *Clipper* programs.

■ **FIXING STRAY CHARACTERS IN DATABASE FILES:**
Automating the clean-up process.

■ **MAKING YOUR OWN PASCAL PROGRAMS RESIDE IN MEMORY:**
The ins and outs of writing TSR code.

there any utilities or printer libraries that will let us incorporate PostScript support into our programs?

Stephen Swope
Dayton, Ohio

 You could consider porting your *Clipper* applications back to the environment where they probably began life. With Version 4.0 and continuing with Version 4.1, *dBASE* has PostScript support. Of course, you probably don't want to deal with translations at this point.

Until recently, your only solution would have been a program called *QuickDraw*, a \$259 utility that reads .DBF files and generates PostScript output (Computer Connection, Eau Claire, Wis.; (715) 833-2331).

But that's not as good as owning a library of routines you can insert into your program.

A library that offers exactly what you want is just coming on the market as of this writing, so it hasn't been tested by anyone at *PC Magazine*. It's called *The Extra Sensory PostScript Library* and is available from Extra Sensory Software (Sherman Oaks, Calif.; (818) 981-8367; \$189). It's worth your while to call them up and ask plenty of questions before buying to make sure the library provides access to the PostScript features you need.

FIXING STRAY CHARACTERS IN DATABASE FILES

Occasionally an end-of-file marker gets inserted in the middle of one of the many .DBF files we use in a *Clipper* application. While it is relatively simple to remove this marker using *The Norton Utilities*, the problem is that we could continue to work for several days without even knowing that one of the files has been corrupted and producing reports with missing records.

Do you know of any way we can test routinely—by running a batch file on a daily basis—for such superfluous end-of-file markers?

Gerald Pragier
Petach Tikva, Israel

 The latest release of *The Norton Utilities*—Version 5.0 (Peter Norton Computing, Santa Monica, Calif.; (213) 319-2000; \$179)—will let you do a search-and-replace on end-of-file markers or any other ASCII character. It's a new feature and greatly enhanced from the earlier search-only capabilities of *The Norton Utilities*; there's even a .DBF file fixer that will look for and correct other types of database file problems. You could set it up to do routine processing of your .DBF files with every running of your AUTO-EXEC.BAT routine. If you've registered your current copy, the upgrade cost is \$49.

But there's a *dBASE*-specific tool that

Advisor

you should look into if you're having any kind of .DBF file corruption.

dSalvage (Comtech Publishing Ltd; Pittsford, N.Y.; (800) 456-7005; \$99) will find and fix any suspicious-looking characters in a .DBF file. The publisher offers a diagnostic program as a free sample of what *dSalvage* will do, and that utility alone will solve your problem, since it runs from a DOS batch file.

MAKING YOUR OWN PASCAL PROGRAMS RESIDE IN MEMORY

I'm in the process of developing a simple address program to use within my word processor and would like to, if possible, make the address program run on a terminate-and-stay-resident (TSR) basis. What necessary modifications do I have to make to the source code of a *Turbo Pascal*, Version 3.0, program to enable it to become a TSR? Is it possible to create a TSR utilizing Version 5.0?

Mark Connors
Honeoye, New York



The process of making a program function as a TSR is not dependent on the version of the compiler you're using, it's a question of including code in your program that will monitor keyboard input, suspend operation of the underlying program while your pop-up takes over, and then neatly return control of the machine to the base program without damaging the current RAM state. It's not an easy programming skill to learn on your own.

You'll save a lot of time by buying a library of *Turbo Pascal* routines that you can insert into your program at the proper place so that when you compile the code your program will be activated by a hotkey sequence.

You'd probably be smart to upgrade your version of *Turbo Pascal* just to take advantage of the better debugging and compiler speed in the latest version, 5.5. But it will also make your memory resident work much easier.

Turbo Power Software's *Turbo Professional* has a variety of routines (including TSR code) and is generally acknowledged as the most comprehensive and well-designed set of libraries for

Turbo Pascal (Scotts Valley, Calif.; (408) 438-8608; \$150). However, it doesn't support versions earlier than 4.0.

If you absolutely want only TSR functions from a library, you should look at *TesSeRact*, a small \$25 set of libraries sold as shareware (TesSeRact Development Team, Jenkintown, Penn.; (215) 884-3373). It too supports only post-4.0 versions of Turbo Pascal.

If you're still determined not to upgrade, log onto Borland's programmer's forum on CompuServe and look in the Turbo Pascal data libraries. There's a file there called STAY42.ARC that will offer some help. (To subscribe to CompuServe, follow the instructions for joining PC MagNet on page 8 of this issue; once you're connected, type GO CIS and then GO BPROG to find Borland's Turbo Pascal files.)

ASK THE ADVISOR

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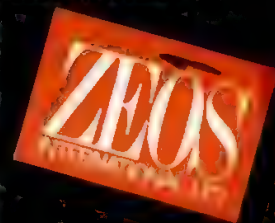
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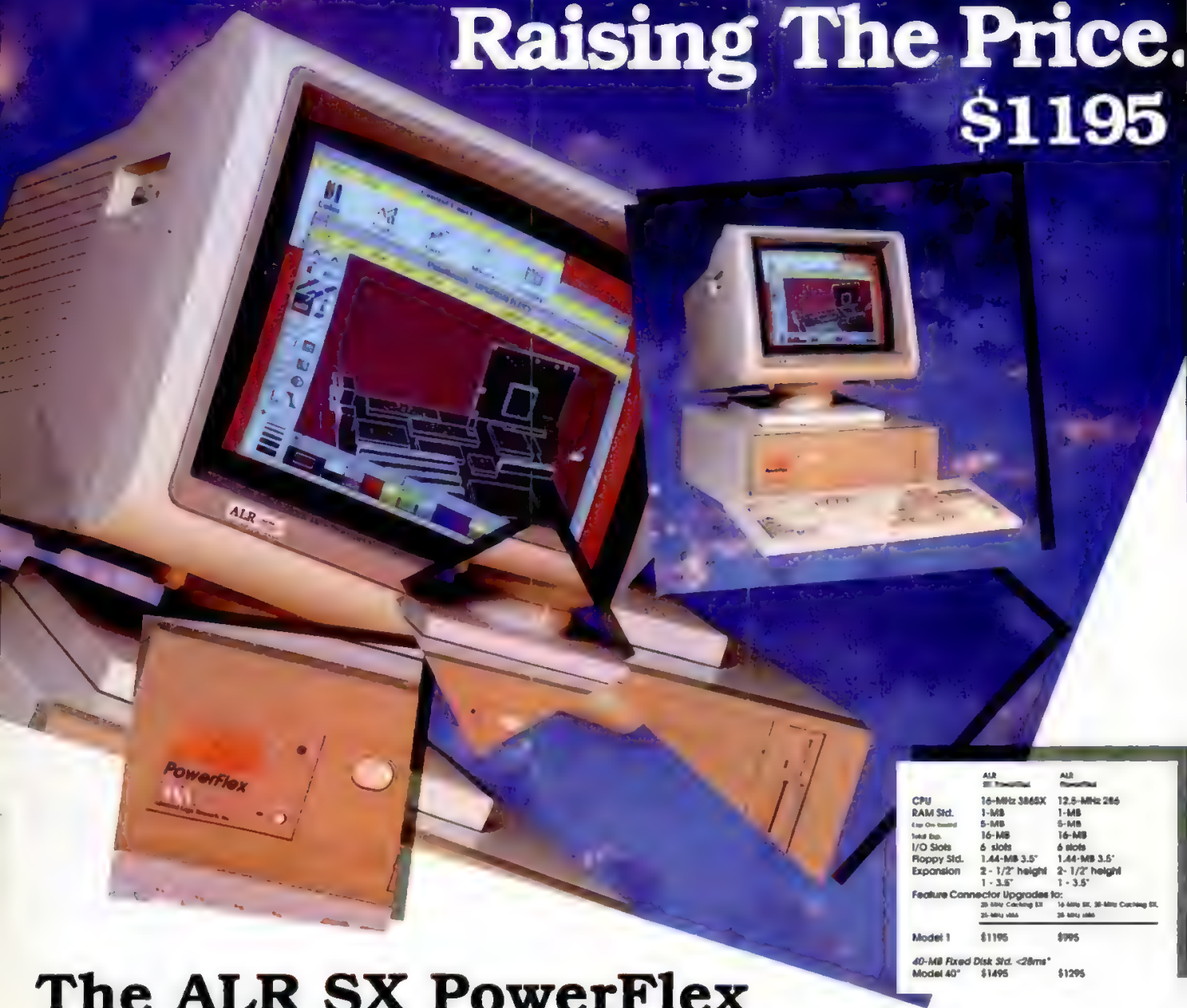


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Floppy Std.	1.44-MB 3.5"	1.44-MB 3.5"
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	1 - 3.5"	1 - 3.5"
Feature Connector Upgrades for:		
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40-MB Fixed Disk Std. <28ms*		
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CIRCLE 165 ON READER SERVICE CARD

First Looks

Hands-on Reviews of the Latest Products

DataEase SQL 1.0 Takes the Sting Out of SQL Queries

HANDS ON
by Joe Salem

DataEase has consistently done well in *PC Magazine*'s evaluations. An Editor's Choice was awarded to two previous versions (in our November 15, 1988, and January 17, 1989, issues) and Version 4.0 won honors as "The Best of 1988" (January 17, 1989). *DataEase SQL* 1.0, the first major update since the release of Version 4.0 almost two years ago, continues the winning tradition with a big

addition: access to SQL database servers in both DOS (3.1 and later) and OS/2 (character mode) versions.

The initial release of *DataEase SQL* supports the Microsoft *SQL Server* 1.1 (see the sidebar "Microsoft SQL Server 1.1"), as well as the native *DataEase* format. Support for the IBM OS/2 Extended Edition *Database Manager*, *Oracle Server* and *Teradata DBC/1012*, and *Micro Decisionware's Database Gateway for DB2* is also planned.

Current *DataEase* users won't notice any change in how *DataEase SQL* looks and works. All function keys and menus act the same and the interface is still forms-oriented. The only time you'll notice a difference is when you are creating a new application or a form.

When first creating an application, you have to specify where the application and the database/engine (server or local) reside. One caveat: a database must already exist on the server; it can't be created through *DataEase* because you have to use *SQL Server's* SAF

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Affordable 24-Bit, Single-Pass Color Scanning from Epson

HANDS ON
by Laura Simone

Have you noticed how many people now have extended VGA cards and color PostScript printers but no inexpensive way to generate high-quality bit-mapped images? Good news: the Epson ES-300C has arrived. The ES-300C delivers 24-bit, 300-dot-per-inch color images at a price that even individual users can afford. List price hovers around \$2,500: \$1,995 for the scanner itself, and \$495 for the DOS Interface Kit, which includes four major image editing packages.

The Epson accepts originals up to 8.5 inches by 11.67 inches, which means that most photographs, magazines, and books fit comfortably on the glass scanning area. The scanner weighs 20 pounds, and is the size of an average printer: 4.8 by 12.6 by 20.1 inches (HWD). A front panel contains buttons

to control built-in zoom and brightness, as well as DIP switches to invoke all of the scanner's features.

The ES-300C can produce 1-bit monochrome data (black and white only), 8-bits of gray-scale data (256 tones), or 24-bits of full-color information (16.8 million hues). Like many of its higher priced competitors, the ES-300C scans an image by firing all three of its colored light sources (red, green, and blue) in a single pass.

This proprietary TruePass design uses three separate fluorescent lamps, each of which is filled with an appropriately colored gas. The company claims that this system will provide truer color over the life of the scanner. The hardware also supports a mode where three separate passes are made for the red, green, and blue sources, as well

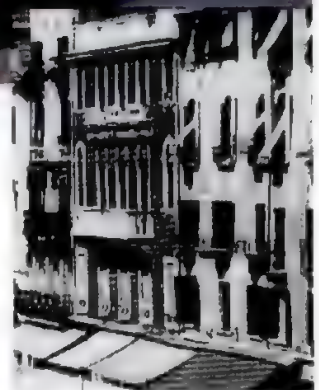
CONTINUED ON 36



The Epson ES-300C scanner produced this table-top shot (left) with *HALOScan Color* at 24-bit and 150 dpi. Final output is via *PageMaker* and a high-resolution printer.



Picture Publisher's calibration routines for the Epson produced superior gray-scale images, as shown in the 8-bit scan of the Grand Canal in Venice (right). The screen image (above) needs 10.5MB of disk space and appears in the edit window at 300 dpi and 24-bit color.



First Looks

A More Graphic 1-2-3 Coexists with Windows 3.0

WANTED ON
by Craig Burrows

Release 3.1 remedies two deficiencies of *Lotus 1-2-3*, Release 3.0—its inability to run under *Windows 3.0* (except in *Windows'* real mode) and its lack of spreadsheet/financial publishing features. Release 3.1 can be run as a DOS task within any operating mode of *Windows 3.0*, and with its new publishing add-in, Release 3.1 boasts printing and graphics capabilities far beyond those offered in the recent Release 2.2 and *Allways* bundle.

The upgrade also makes Release 3 more useful with extremely large worksheets or many smaller ones at once. Even though the core product (without its publishing add-in) uses about 200K more RAM than Release 3.0 (with a 25-line VGA screen driver installed) it can swap data to disk if memory runs short.

Release 3.1 is not a *Windows* application. Release 3.1 is a DOS program that can be multitasked with other DOS and *Windows* programs under *Win 3*. Release 3.0 couldn't be multitasked under *Windows* because of a conflict between Lotus's

and Microsoft's DOS-extender technologies. But running 1-2-3 in the background under *Windows* elicits its price. You have to install Lotus's CGA screen driver—significantly reducing the usefulness of Release 3.1's publishing features. Fortunately, Release 3.1 can keep two screen drivers on-board at once. So, if you're working on a VGA system, for example, you can

copy of *Impress*, Version 2L.

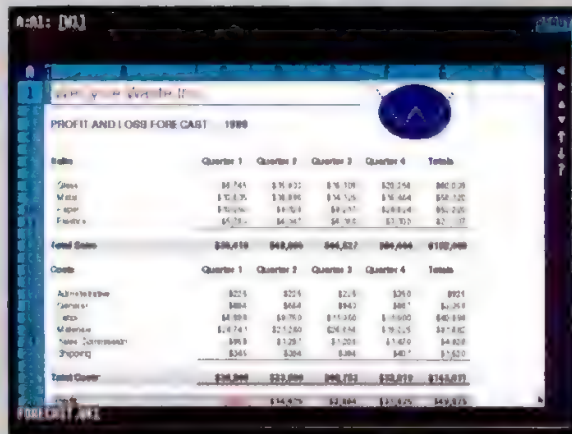
After installing *Wysiwyg* using the Lotus add-in manager, you can either work in Release 3.1's customary "text" display (actually a bitmapped character screen, unless you choose the CGA driver), or choose from a variety of graphics display options. In graphics mode, you can scale rows and columns to anywhere from 25 to 400 percent of their normal dimensions; change the color of any screen element; apply conditional colors to cell values (red for negatives, for example); suppress or display frame and gridlines; change headings from letters and numbers to inches, centi-

densities. Text can be wrapped and centered within any column range, drop shadows applied, and fonts changed within cell entries. These text-handling features take the guesswork out of headlining and let you easily wrap words and numbers around spreadsheet graphs. Applying text formatting within cell entries has one unfortunate side effect, though. It changes the underlying worksheet file, not just its accompanying file of format information.

Lotus provides four Bitstream fonts in sizes from 3 to 72 points; you can add more Bitstream fonts with the help of Lotus's Install program. Unfortunately, the program still only supports four HP font cartridges. Graphs and data can coexist on the worksheet, and the graphs can be either live (named worksheet graphs that change in response to worksheet edits) or frozen (.PIC files). Logos can be added by importing .CGM images. A Graph Edit command takes you into Release 3.1's equivalent of *Quattro Pro Annotator*, a mini-drawing package with tools for adding arrows, geometric shapes, text, and freehand figures. *Wysiwyg* also provides print settings sheets, the ability to save page-layout libraries, a print preview screen, and a Compress command that scales any print range to fit on a single page.

Release 3.1 offers huge advances in spreadsheet formatting, but there's one hitch. You now have two separate menu systems to master. The *Wysiwyg* menu tree (invoked by typing ":",") is almost as complex as Release 3.1's own, and in some places the functionality overlaps. Both trees have Graph and Print menus, for example, but they offer completely different sets of options.

Release 3.1 is a strong spreadsheet publisher. Its text handling and printing options are richer than *Quattro Pro's* (but its font support is weaker), and its ability to integrate graphs and worksheet data gives it a leg up on *Microsoft Excel*. But you may find it more difficult to learn than programs designed from the onset with publishing functionality in mind. ■



Lotus 1-2-3, Release 3.1, now capable of running under *Windows 3.0's* protected mode as a DOS application, also offers rules in three weights, shading in three densities, drop shadows, and the ability to mix text and graphics.

use the 25-line VGA driver as your primary screen, then switch to the CGA driver when you want it to run in the background under *Windows*.

To achieve spreadsheet publishing capability, Lotus bought and bundled *Wysiwyg*, a 1-2-3, Release 3 version of PC Publishing's *Impress* add-in and a popular *Allways* competitor. *Wysiwyg* is a more-versatile product than *Allways*, and .WK1 files formatted under *Allways* can be read into *Wysiwyg*. Similarly *Wysiwyg*-formatted .WK3 files can be exported to Release 2 and read by *Allways* (only formatting options supported by *Allways* are retained). For complete formatting compatibility with Release 3.1, Release 2 users may opt to buy a

meters, or picas; and switch between transparent and opaque cell pointers.

In any display mode, *Wysiwyg* can use a mouse for command selection, navigation, or range selection. Ranges can be selected before or after commands are issued. If you preselect, the selected range remains highlighted, so you can apply several commands to the same range.

But you can't simply drag the mouse across a range; you have to press a key to "anchor" the range before dragging. Those used to other mouse-driven software will find this a curious and clumsy procedure.

Wysiwyg can apply up to eight fonts, three line weights and borders, and three shading

FACT FILE

Lotus 1-2-3, Release 3.1
Lotus Development Corp.,
Cambridge Pkwy., Cambridge,
MA 02142; (617) 577-8500.
List price: \$595.
Requires: 286-based PC or
better, 1MB RAM, hard disk,
DOS 3.0 or later.
In Short: Release 3.1 gives
1-2-3 its much-needed
publishing features, mouse
support, and the ability to run
under *Windows 3.0* in protected
mode. Since these
enhancements are achieved
via an add-in, users must learn
an entirely new command
system.

CIRCLE 716 ON READER SERVICE CARD

First Looks

DataEase

CONTINUED FROM PAGE 33

(Server Administration Facility) to create any database. The created application is then tied to that database, and it automatically logs the user in.

When you create a form that references a new data table, you will be asked to specify its name, location, and format prior to saving it. You'll notice that the *DataEase* native format is one of the options, even though the primary database is on the *SQL Server*. This is because *DataEase* lets you combine data from multiple sources in one application.

If you are creating a form on an existing table, you're given an option screen where you can choose fields from a pick list. All of the relevant information is entered into the field definition for you. Once the form is created, the links to the data are automatically generated as the form is used; the only indication the user has that the data may not be on the local disk is a very slight delay in the response time.

The *DataEase* approach is more transparent than *Paradox's Paradox SQL Link* (reviewed on page 38 of this issue). The secret to this transparency is PRISM—the Processing Router for Integrated SQL Management. PRISM



FACT FILE

DataEase SQL, Version 1.0
DataEase International Inc., 7
Cambridge Dr., Trumbull, CT
06611; (203) 374-8000.

List Price: Professional
(developers version), \$995
(upgrade, \$250); Workstation
Master, \$1,500 (upgrade,
\$750); five-user Workstation
Pack, \$1,750 (upgrade, \$150
per workstation); Application
Developers Kit (includes
Microsoft SQL Server and
three copies of Professional),
\$5,995.

Requires: 2MB RAM; OS/2 1.1
or later, Microsoft SQL Server
1.1 or later; either LAN
Manager 2.0, 3+Open 1.1 or
later, or NetWare 2.1 (with
OS/2 Requestor); DOS 3.1 or
later.

In Short: *DataEase SQL* takes
the traditional, easy-to-use
DataEase interface, and
effortlessly integrates it with the
SQL server environment.

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automatically translates *DataEase* functions and DQL (*DataEase* Query Language) statements into SQL requests. PRISM optimizes the SQL constructs to the native SQL server language, so that only the smallest and most-efficient commands are passed to the server. Because of this, it's not necessary for an applications programmer to ever write a line of SQL code.

Programmers familiar with DQL can be writing *DataEase SQL* applications in no time,

and existing *DataEase 4.x* (as well as *dBASE*, *Lotus 1-2-3*, and *Paradox*) applications can be imported directly. There is also an EXEC SQL command, for including native SQL statements in an application.

Many factors affect the performance of a SQL database server front end, the biggest factor being the speed of the server itself. Informal testing indicates that accessing the server usually imposes only a slight delay in processing. Because of PRISM's optimization, combined with the distributed processing powers of the SQL database engine, some operations are even faster than on a native database.

One example of this is indexing records. Generally, at least one field in each table should be indexed. *DataEase SQL* allows you to index while creating the form, or lets you modify an existing form, adding or removing indexed fields. The indexing request is sent to the server, and you're immediately returned to *DataEase*; all indexing is done by the SQL

server engine.

The programmers at *DataEase International* have done a good job in integrating *DataEase* into the Client/Server environment. *DataEase* offloads as much processing as possible to the database engine. There are a few cases when the processing is done on the workstation and these mostly involve JOINS.

Importing data can be quite a problem area; *DataEase SQL* supports multiple import formats, such as *Lotus 1-2-3/Symphony*, *DIF*, *dBASE*, and variable and fixed-length ASCII. However, the built-in process is very slow. In the meantime, *DataEase* recommends that you use the data-import utility provided with your particular SQL server software.

DataEase SQL is expensive, and its RAM requirements for DOS workstations are high. While upgrades are available for *DataEase 4.2* users, the list prices may break many a budget. In spite of this, *DataEase SQL* is an excellent front end to SQL servers. ■

MICROSOFT SQL SERVER 1.1.

Microsoft's *SQL Server 1.1* (co-developed with Sybase) works with LAN Manager 2.0 and 1.x networks, as well as IBM LAN Server 1.2-based LANs (with the appropriate CSD from IBM).

The new release no longer requires a LAN. It loads on a standalone machine, making it ideal for developers who want to program SQL database server applications, but don't have access to a LAN. The package has the programming tools and libraries for writing front-end applications in C (under DOS, Windows, or OS/2), or in MS BASIC PDS 7.0.

The *SQL Server* is administered through the SAF (Server Administration Facility); both DOS and OS/2 versions are included. Besides administration, the SAF serves as a direct front end to the server, and can access databases on the server using the native

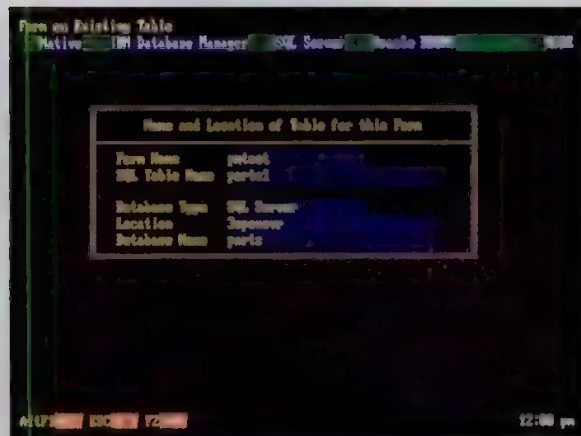
TRANSACT-SQL language.

The base price for a one to five concurrent-user version is \$995. Modules that add 10 users are also \$995. An unlimited-user version is available for \$3,195. Until the first of the year, Microsoft is bundling Lotus Development Corp.'s *SQL Server to Lotus 1-2-3* and Pioneer Software's *Q+E*.

The five-user version is an excellent introduction to SQL database servers. As your needs grow, you'll have many options for expanding the basic capabilities of the package.—JS

List Price: Microsoft *SQL Server 1.1*, base version \$995, unlimited version \$3,195.
Requires: OS/2 1.1 with a minimum of 8MB RAM for the standalone version; LAN Manager 1.x, 2.0 for network. Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; (206) 882-8080.

CIRCLE 705 ON READER SERVICE CARD



This Form Creation screen shows how easy it is to link a *DataEase* form with a database on a SQL server.

First Looks

Epson

CONTINUED FROM 33

as the ability to drop out one of the primary colors from the scan (color dropout can enhance detail in monochrome images).

Other hardware features: scaling factors between 50 and 200 percent, 7 brightness levels, 19 discrete output resolutions from 50 dpi to 600 dpi, three built-in half-toning patterns, and two types of gamma correction for CRTs. (Gamma correction creates a linear relationship between the screen image and the base file resulting in more accurate image editing.)

All of these hardware features can affect the quality of the scanned image. Unfortunately, the only way to access many of these hardware features (such as three-pass scan with dropout color) is to use a special mode that allows the Epson to function as a sort-of copier. You can scan an image directly to the printer, using the front panel and DIP switches to determine the proper settings. Usefulness is limited, however, because the ES-300C supports only four printers directly—the Epson LQ-860, LQ-2500, the HP PaintJet, or the HP 3630.

For normal scans meant to be saved to a file, you must rely on software to control the ES-

300C. The DOS Interface Kit, with the bidirectional parallel I/O card (the cable is not included), comes with four software programs: Astral Development Corp.'s *Picture Publisher Plus*, *HALOScan Color* from Media Cybernetics, Computer Presentations' *Color Lab ES-300C*, and Image-In's *Scan, Paint, and Plus* modules. Deciding which program suits your needs is confusing and time consuming, for no single program takes advantage of all the features built into the ES-300C.

The three color-capable products, *Picture Publisher Plus*, *HALOScan Color*, and *ColorLab ES-300C*, all force you to use their own algorithms for gamma, contrast, and brightness correction. They'll take advantage of the firmware's zoom and dpi settings, but they scan the image with a flat gamma curve. As a result, color images require a considerable amount of adjustment prior to printing. Images that look good on screen will produce "muddy" printouts, and good printouts will often look washed-out on screen. Each program has its own blend of advantages and disadvantages.

Picture Publisher has a special calibration setting for the Epson scanner that improves tonal accuracy—with dramatic results on gray-scale images. But it employs a kludgy viewing scheme that requires you to shell out of *Windows* in order to see 256 colors on screen. It offers the most extensive editing capabilities of all four programs including masking, sharpening, and gray-map editing.

HALOScan Color produces the fastest scans. Its proprietary interface and memory management scheme (it is the only non-*Windows* program of the bunch) allows multiple images on-screen simultaneously. It provides only overall gamma correction for RGB values, but has outstanding error diffusion methods for printing on low-resolution devices like the HP PaintJet.

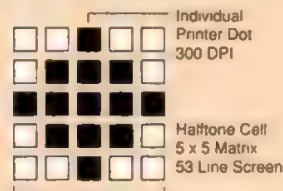
ColorLab ES-300C has full-color capabilities, and concentrates on palette optimization. The enhancement features are restricted to either global or

THINK BEFORE YOU SCAN

Creating a multi-megabyte bitmapped image using a scanner is easy. Transporting a large file between systems, or incorporating it into DTP documents is hard. But, the simple truth is that you don't need 10 megs of information to produce quality output.

Bit depth determines the number of colors in a file: 1 bit for black and white, 8 bits for 256 colors or gray shades, and 24 bits for 16.8 million colors. Except for 1-bit images, where each dot on your scanned image corresponds to a printed dot, there is no direct correlation between the dpi of your scanned image and the dpi of your printer.

Gray shades and colors are printed out using a convention developed by professional



This pattern represents a 52% gray shade on a 300 dpi laser printer.

printers called halftone dots or cells. A halftone cell is actually an aggregate of printer dots. If a halftone cell is composed of a modest 5 by 5 matrix of printer dots, a 300-dpi laser printer can produce—at maximum—60 halftone cells per inch.

Since halftone cells are traditionally printed in angled rows or lines, printers measure image resolution not in dpi, but in line screen frequencies. Magazines like this one are printed at 120 or 133 lines per inch. Your 300-dpi laser printer, with an angled halftone pattern, is capable of about a 53-line screen frequency.

The basic rule when scanning a color or gray-scale image is to scan at a dpi setting 1.5 times greater than the final line screen setting. For laser printer output, an 80-dpi scan is more than sufficient. Even a high-resolution 133-line screen requires an original scan of only 200 dpi. The lower scan settings will result in more-efficient file sizes, and the same high-quality images.—LS

RGB color changes. At the moment the program works only under *Windows 2.x*.

Only the monochrome-based products from Image-In take advantage of the scanner's halftone patterns and gamma correction routines. Noticeably absent from the bundle is Image-In's OCR module (or any OCR software) which could have broadened the scope and usefulness of this package.

These four programs cover the spectrum of file formats: full-color .TIF, .TGA, .EPS, colormapped .PCX, .MSP, .IMG, *MacPaint*, and proprietary formats such as *ColorLab's* .CPI and *HALOScan's* .CUT. In fact, the only formats missing from the software are .GIF and .BMP—both significant omissions.

A scan can generate information-laden files. A six-inch-square color test image,

scanned at 300 dpi, generated 10.6 megabytes of data. More practical files of 1.5MB were produced by lowering the resolution to 100 dpi. The scanned color images were routinely well balanced when displayed on-screen, but the printed output required extensive trial, error, and recalibration.

On the other hand, a single pass scan for gray-scale images produced superb results. .TIF files produced on the Epson ES-300C had stronger highlights, and a wider tonal range than those produced on the monochrome HP ScanJet.

The Epson ES-300C can meet all of your gray-scale needs now with astoundingly good results. But currently, the hardware is way ahead of the software when it comes to color scanning. We can hardly wait for the software to catch up to its colorful potential. ■

FACT FILE

Epson ES-300C

Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; (800) 922-8911.

List Price: scanner \$1,995, DOS Interface Kit, \$495.

Requires: Hard disk, graphics adapter. Other requirements are software dependent.

In Short: The Epson ES-300C has exciting built-in capabilities that the software has not yet begun to tap. Though our testing proved that generating color images—from scan to final output—is still fraught with problems, this scanner can meet all your gray-scale needs now, and prepare you for the color images in your future.

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First Looks

Paradox 3.5: Improved Memory Management, Superior Performance

HANDS ON
by David L. Hoffman

Paradox 3.5 doesn't have the performance problems and memory constraints that existed in previous versions, and it will be particularly welcomed by users with memory-hungry networks. Whether you are a current *Paradox* user or a newcomer, this upgrade warrants serious consideration.

Almost every major operation in *Paradox 3.5* is faster. Memory-intensive processes that could barely run on a networked PC under *Paradox 3.0* will now execute effortlessly. SQL support has been added (see "The SQL Link"), and 3Com's 3+Open network software is supported. Finally, you can now use variables and functions in reports and forms.

Borland International has totally revamped *Paradox's* memory management by borrowing from the virtual memory techniques used in *Quattro Pro*. The result is stunning perform-

ance gains. We ran informal tests on Versions 3.0 and 3.5 to determine the performance improvement. Using a 386SX with 2MB of RAM and a single database with over 4,000 records and 24 fields, we found a sort process to be three times faster in the new version; the query process was approximately twice as fast.

Users with 286, 386, or 486 processors and 1MB or more of memory will experience the greatest performance improvements, because *Paradox* takes advantage of protected mode, allowing up to 16MB of extended memory to be accessed directly. Borland claims that even 8088 machines will reap performance benefits, and EMS (expanded) memory is still fully supported.

Paradox 3.5 detects the kind of hardware it is running on and configures itself accordingly. There are a variety of user-specified memory management options, but in most cases *Paradox* determines the optimal configu-

ration on its own. A new diagnostic option issues a full report on the hardware setup, including processor type, utilization of memory, display type, and available space on each disk drive.

Aside from its vast performance improvements, this upgrade mainly offers small but nice touches. For instance, current users appreciate *Paradox's* shortcut facility for making a menu choice by typing its initial letter, but until now, the user was forced to point and shoot in a tie-breaker situation. *Paradox 3.5* introduces incremental menu selection, so that a menu that includes APAYABLE and ARECEIVE will allow the user to type AP to select APAYABLE. Version 3.5 offers import/export ability with Borland's *Quattro Pro* and *Reflex 2.0*. The color-customization system, which was awkward and confusing in *Paradox 3.0*, has also been overhauled.

Paradox 3.0 introduced the concept of multitable forms, al-



FACT FILE

Paradox, Version 3.5

Borland International, 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95066-0001; (408) 438-8400.
List Price: *Paradox 3.5*, \$795; upgrade from Version 3.0, \$149.95. (If you can upgrade before November 7, 1990, it's only \$134.95.)

Requires: 512K RAM, hard disk, DOS 2.0 or later.

In Short: An enhanced version featuring substantial speed increases and improved memory management on all classes of PCs.

CIRCLE 702 ON READER SERVICE CARD

lowing up to five detail tables to be embedded within one master form. Version 3.5 increases this limit to nine embedded tables.

Paradox's built-in programming language, PAL, can now have its variables and more than 50 of the most important PAL functions included in reports and forms. Even nonprogrammers can easily use the Format function to incorporate numbers with floating dollar signs into reports or create data entry forms that can calculate and display loan payments.

Other additions to PAL include a new NOSHELL option in the RUN command, which allows an external program to relay a DOS return code to *Paradox* after its execution. A new option in the SHOWMENU command lets the programmer trap for inappropriate keystrokes when a valid menu selection is expected. *Paradox's* incremental menu behavior also applies to programmer-defined menus and a new function, RECORDSTATUS, allows the programmer to check for locked records and key violations.

With Version 3.5, all of the features of *Paradox 3.0* and *Paradox 386* (an older, protected-mode version) have been consolidated into a single package. As the dBASE world continues to fragment with competing products, utilities, and dialects, Borland has demonstrated a consistent upgrade philosophy and retained its commitment to both past and future *Paradox* users. ■

THE SQL LINK

Along with *Paradox 3.5*, Borland International is releasing *SQL Link 1.0*, a \$495 add-on that lets *Paradox* users access data from an SQL database server.

Installing *SQL Link* is simple; its functions become a part of the normal *Paradox* menu. In order to access data from an SQL server, you must first run a *SQL Link* utility that creates a replica table. Replica tables don't contain data; they're used to translate the data between the server's format and *Paradox*.

Once the replica is created, *Paradox* translates a request for data from the server into an SQL statement, and transmits it to the server. The response

is sent back to *Paradox* and is converted into a standard *Paradox* ANSWER table, using the replica table as a model. The ANSWER table can then be manipulated or saved locally, just like any other *Paradox* table. *SQL Link* supports full transaction processing and data security on the server.

SQL Link adds PAL statements that let the programmer access the SQL server through a custom application. It also adds the ability to send native SQL commands to the server from a PAL application; however, only one native SQL command can be used at a time, because the commands can't be nested.

The integration of SQL ac-

cess into *Paradox* isn't entirely seamless, and it adds a level of complexity in the translation process, but *SQL Link* is a good first attempt at integrating an SQL front end into a familiar PC database product.

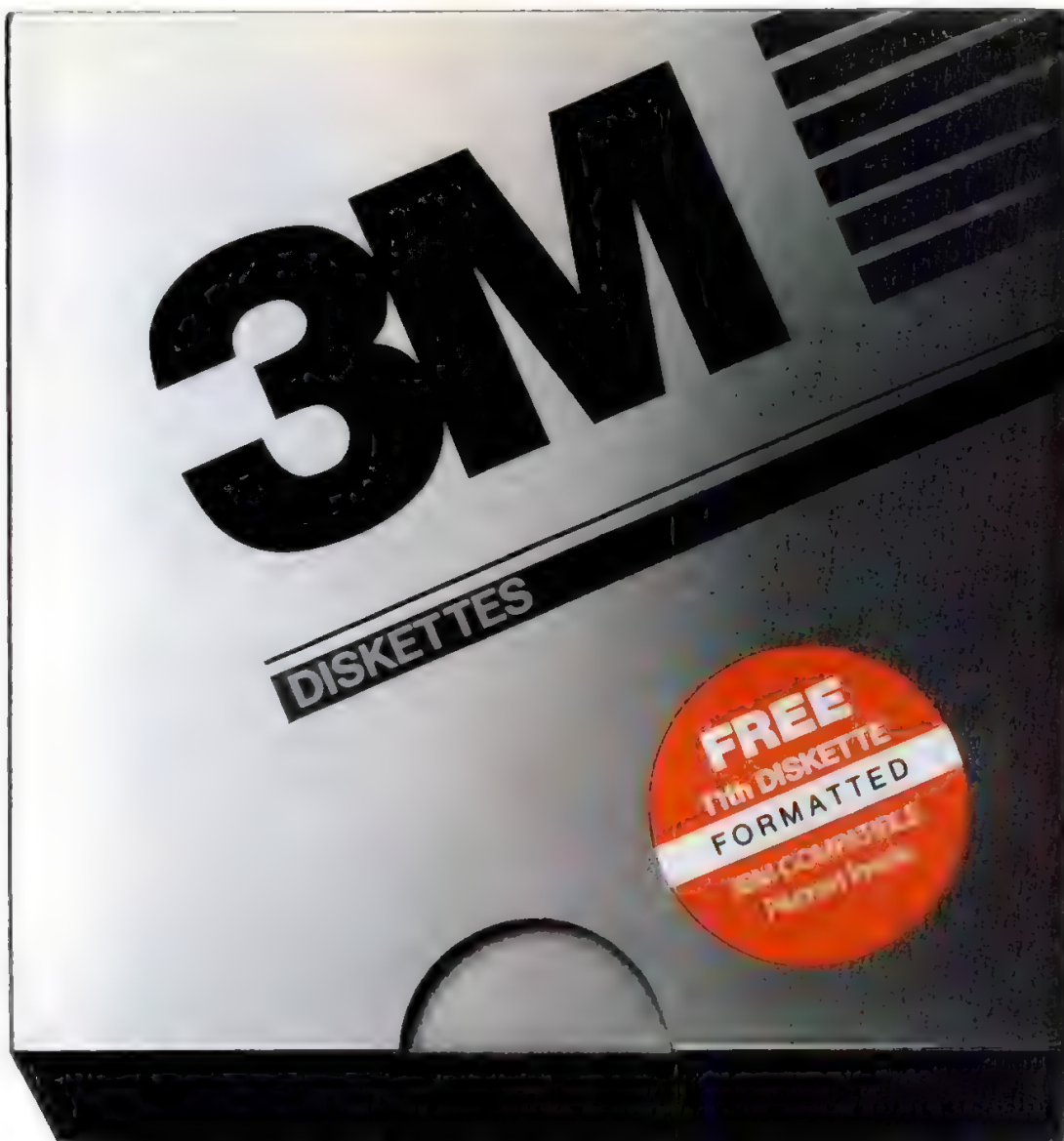
—Joe Salemi

List Price: *SQL Link 1.0*, \$495.

Requires: *Paradox 3.5*, 80286 processor, 1MB RAM.

Supports IBM's OS/2 Extended Edition Database Manager 1.2, Microsoft SQL Server 1.0, and Oracle Server 6.0. (The Oracle Server requires 1.5MB RAM.) Borland International, 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95066-0001; (408) 438-8400.

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- 101 Enhanced keyboard
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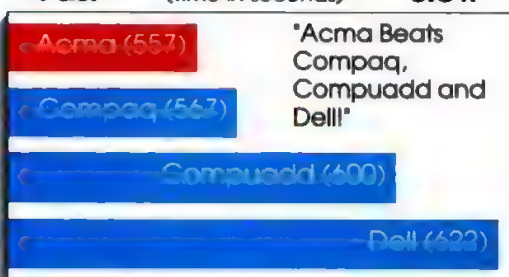
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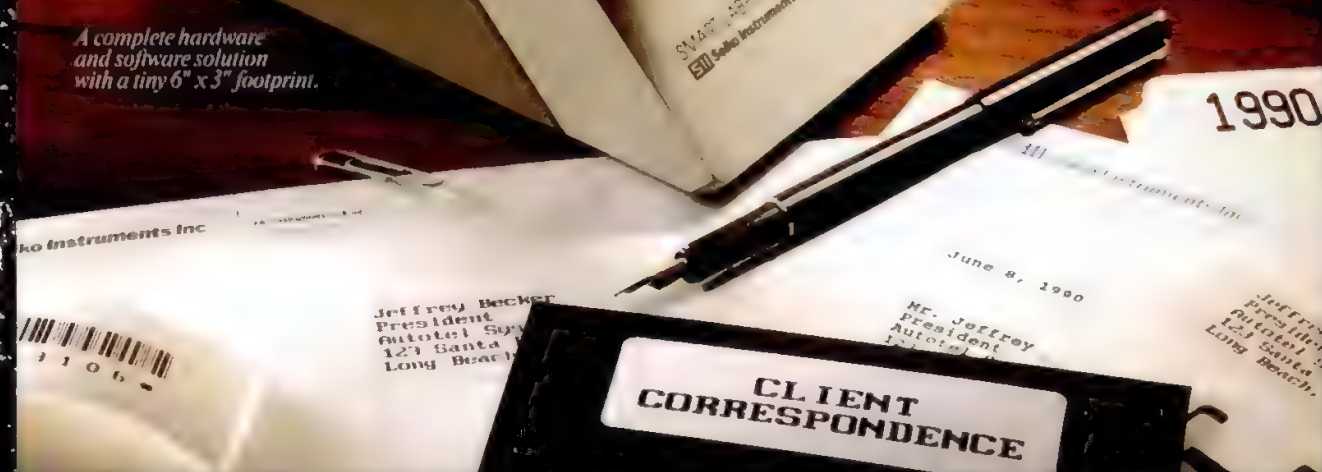
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Expanz! Board Quickly Compresses Files On All Disk Types but Forfeits Some DOS Compatibilities

HANDS ON
by Edward Mendelson

InfoChip Systems' Expanz! on-the-fly file-compression/expansion board is a \$199 alternative to purchasing a new hard disk that might cost hundreds of dollars more. When you plug the board into any 8- or 16-bit slot in your computer, it transparently compresses all files written to your disk, and transparently decompresses them when you load them into memory again.

Once you initialize a disk so that it works with the board (a procedure that also compresses any files already on the disk) files that you modify or create will fill as little as one-tenth the space that they would normally. You can even compress all the files on the hard disk partition from which you boot.

The only software that you need is a driver that loads automatically into RAM from your CONFIG.SYS file—plus DOS 3.1 through 3.3. The board doesn't yet work with DOS 3.31 or 4.0, OS/2, or network operating systems, although a driver for DOS 3.31 or above is promised for later this year.

Expanz! performs its compression and decompression via hardware on the board. Compression is performed by an algorithm built into the proprietary IC-105 coprocessor. The process is so fast that you'll probably never notice the difference. Software-based, on-the-fly file-compression schemes, in contrast, tend to cause noticeable delays and ask you to set aside only a part of a disk for compression rather than the full disk.

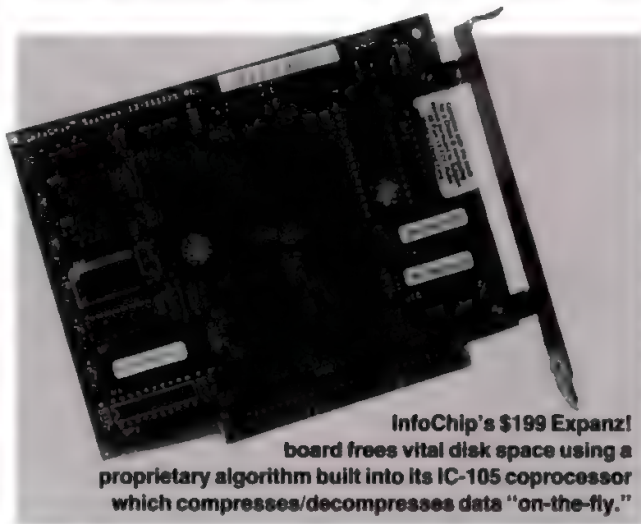
The price you pay for this compression is a hefty 30K of RAM lost to the driver, 16K of high memory addresses used as a memory window, and the inability to use many disk utilities

that you may rely on for security and speed. Once a disk is initialized to work with the Expanz! board, you'll scramble your data if you use any defragmenters or other disk-repair utilities on the disk like *The Norton Utilities'* Disk Doctor or any of its files. InfoChip is considering writing defragmenters and other utilities to use with initialized disks, but can't predict a delivery date.

You can run unerase programs without damage, but you won't recover the data you want. If you try to run CHKDSK on an Expanz!-initialized disk, you'll lock up your computer. The board comes with software that includes a replace-

pulls it from the computer, emulator software is automatically loaded on boot-up so you can still use your data, although at a noticeable speed penalty. If hard disk problems make you boot from a floppy, you'll have to use a "safety" disk created during installation, otherwise you risk losing data on your hard disk. Anyone who uses this board should have plenty of "safety" disks readily available, and be able to ensure that no one will ever try to boot the machine from a standard DOS disk.

You can initialize virtually anything that uses a drive letter to work with the Expanz! board. InfoChip claims that all hard



ment for CHKDSK. It also gives you a replacement for DOS's DIR command that tells you the compression ratio for your files. DOS's own DIR will tell you the uncompressed size of the files because the board's software tricks DOS into thinking that your files are in their original state when in fact they're squeezed.

Once you initialize a disk, you can't access data on it without using the board's software. If the board fails or someone

disks work smoothly including ESDI, IDE, and SCSI models, although you can't compress the boot partition when you use Western Digital Corp.'s FAST SCSI board. SpeedStor and similar third-party partition software works well, although only with DOS 3.1 and 3.2.

You can initialize floppy disks (although not bootable ones) and even a RAM disk. However, you can't initialize WORM drives or Bernoulli boxes, and, because you can

FACT FILE

Expanz!
InfoChip Systems, 2840 San Tomas Expwy., Santa Clara, CA 95051; (800) 447-0200, (408) 727-0514.
List Price: \$199.
Requires: Any non-MCA expansion slot; 512K free RAM; 1MB free on any hard disk to be used with the board; DOS 3.0 through 3.3.
In Short: An expansion board that transparently compresses files written to virtually any DOS disk. The savings in disk space may not be worth the restricted use of disk utilities.

CIRCLE 436 ON READER SERVICE CARD

only initialize a writable device, you can't make Expanz! compress data on a CD-ROM. The board also has no effect on most tape drives.

PC Labs tested the Expanz! board on a 25-MHz 386 clone computer with a 170MB Maxtor ESDI hard disk. With the board installed, disk-access benchmarks typically showed a one to five percent speed penalty over their performance without the board; this penalty increased to 20 percent in some DOS file access tests with small records. Compression ratios achieved by the board ranged from around 1.6:1 with executable files to above 10:1 with some graphics files. Most of the word processing files we shrank were compressed by about 2:1.

The Expanz! board can generate enormous savings in disk space, especially if you use highly compressible files like graphics, spreadsheets, and databases. But to achieve those savings, you'll have to be willing to store your data in a format that DOS won't recognize without a special driver, and limit yourself to DOS 3.3 disk partitions until InfoChip releases new drivers. You'll also have to be certain that no one is going to bring a defragmenter, *The Norton Utilities'* Disk Doctor, or similar programs anywhere near your disk.

If you can live with these limits, you'll find the Expanz! board to be a technical marvel that does its job quickly and transparently. ■

First Looks

Intel's NetPort: A Direct Hook to Printer Sharing

HANDS ON
by R. Dennis Bower

On most networks, shared printers must be next to the file server. While the latest versions of *NetWare* allow you to establish a separate PC as a print server wherever you need one, you still have to buy a PC to manage the shared printer. Intel's \$695 NetPort attaches to the side of your printer with Velcro tabs and hooks directly into your LAN's Ethernet cable—eliminating the need for the PC.

The NetPort is a self-contained unit about the size of a paperback book (4 inches high by 7.5 inches long by 1.25 inches deep). The compact case packs a Hitachi microprocessor (the equivalent of a Z180 chip), 64K of Flash memory, 16K of buffered memory between the network card and printer side, an Ethernet LAN adapter card,

and the software necessary to act as a printer attached to a *NetWare* server. In addition to its Ethernet port, the unit has both serial and parallel ports, allowing it to simultaneously drive two printers.

One of the key benefits of the NetPort print server is its "plug-and-play" installation. You can install NetPort as a print server without using an NLM or VAP. As the supervisor, all you do is identify the NetPort printer utility to *NetWare*'s PCONSOLE. PC LAN Labs finished this installation and configuration in five minutes without disrupting operation of the network.

Another installation method uses NetPort as a host for remote printers under Novell's *NetWare* Print Server NLM or VAP. The VAP/286 version requires taking the network down to set up any new printer. The

NLM/386 version requires that you unload and reload the PSERVER file at the communications server. But either option lets you connect up to 16 printers per server.

The third installation method sets up NetPort as a virtual circuit. While this has few applications now (only *RoboCAD* requires two-way communication with the printer or plotter), Intel has plans for further development of the virtual circuit in later releases.

At NetPort's core is Intel's Flash EEPROM technology. This programmable chip allows for future upgrades through software instead of replacing the chip. Once downloaded from Intel, the new software code remains in "non-volatile" memory, eliminating the need for a battery backup inside the unit. With multiple NetPorts on the network, LAN administrators can upgrade all the network NetPort servers from a single console. Each unit has its own set of command line utilities to let the LAN manager send and

NetPort turns printers into standalone print servers.

receive status and control information.

NetPort currently runs on Novell *NetWare* 2.1x or *NetWare* 386 with thin-wire Ethernet cable. Intel states plans for additional topologies as well as additional operating systems. Intel provides a three-year warranty for NetPort, plus unlimited toll free technical support. ■ **List Price:** NetPort Server, \$695. **Requires:** Novell *NetWare* 2.1x or higher, or *NetWare* 386. Intel Personal Computer Enhancement Operation, (PCEO) MS CO3-7, 5200 NE Elam Young Pkwy., Hillsboro, OR 97124-6497; (800) 538-3373, (503) 629-7354.

CIRCLE 431 ON READER SERVICE CARD



P/NET: Inexpensive Peripheral Sharing

HANDS ON
by R. Dennis Bower

P/NET from Practical Peripherals lets PCs share printers and modems using standard RJ-11 modular telephone cabling, and eliminates the need for network adapter cards. The system contains the P/NET System Server and satellite I/O devices, called P/Pods. The server is really a small data switch which connects to 16 P/Pod devices.

The server unit, about the size of a telephone answering machine, comes with one megabyte of SIMM memory, expandable to 16MB. It has no controls of its own, and uses 120-volt AC power.

The P/Pod is smaller, the size of a mouse. Pods provide both the connection to the server and the primary interface between users and the P/NET sys-

tem. A pod gets placed at every workstation and peripheral. Its front panel houses eight LEDs to help track the status and connection of the peripheral devices. Each Pod has two switches to provide access to various networks. Unfortunately you need a "diagram" of all the routes and channels in order to use the Pod controls effectively.

Each P/Pod has a parallel I/O port, a bidirectional serial I/O port, and a 75-foot modular telephone cord. Typically, you'd attach your PC's parallel port to the P/Pod, and then attach the RS-232C cable to your PC's serial port and your printer. This lets you share other printer stations through the parallel cable coming from the P/Pod. An RJ-11 cable connects the P/Pod to the P/Server.

P/NET uses high-speed serial communication to attain reli-

P/Pod I/O devices attach to a main server.

able data transfer up to 3,000 feet. All 16 P/NET input and output ports can operate simultaneously at data rates of 9,600 kilobytes per second. However, as the load increases, so does the time to move a job to the printer.

Configuring the P/NET requires that you write complex batch-like configuration files. You'll need your own text editor. The cryptic language and complex routing make installation gruelling. P/NET provides several routing modes. A buffer mode sends files to P/NET's memory buffer. Cable mode is used for modem output; Link mode handles computer-to-computer transfers, but you'll have to supply your own data transfer software.

The \$1,695 P/NET package links four computers, a printer, and a modem. At \$425 per station, P/NET is affordable, but



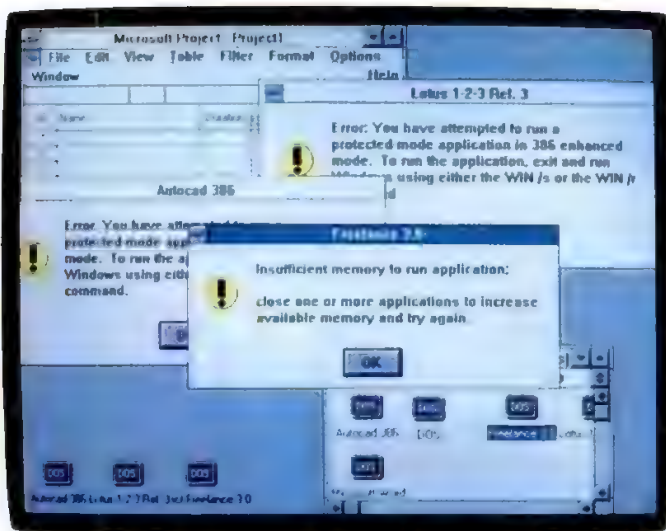
no bargain. Artisoft and Invisible Software offer capable LAN systems for less than \$300 per node.

■ **List Price:** P/NET, \$1,695. Master System includes: system unit server, four P/Pods with power packs, cables, and four 75-foot modular telephone cables. Upgrades cost \$189 per P/Pod. Practical Peripherals Inc., 31245 La Baya Dr., Westlake Village, CA 91362; (818) 991-8200, fax (818) 706-2474.

CIRCLE 434 ON READER SERVICE CARD

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You may want to use DESQview as your primary operating environment.

The new DESQview 2.3 and DESQview 386 2.3 let you use your favorite DOS and DOS-extended programs in windows side-by-side on 80286, 80386 and i486 PCs. As you can see above, you can even run Windows programs

within DESQview 386. So the next time you get error messages like the ones at the left in Windows, remember how the same set of programs look running in DESQview.

Whatever standard you use—DOS, extended DOS or Windows—DESQview is still the best way to get the most out of the hardware and software you own today.

DESQview. The obvious choice.

Quarterdeck

Quarterdeck Office Systems, 150 Pico Boulevard, Santa Monica, CA 90405 (213) 392-9851 Fax: (213) 399-3802

This comparison was made using a system like the one you might run: Both shots show an ALR FlexCache 33/386 running DOS 3.3 with VGA display adaptor, Novell NetWare v3.01 Rev. A, with IPX/SPX v3.01 Rev A, Microsoft Mouse 7.00, and Microsoft SMARTDrive v3.03 disk cache. Buffers were set to 20.

For the Windows screen, we ran Microsoft Windows 3 HIMEM.SYS and EMM386.SYS. For the DESQview screen, we ran QEMM 386 v5.1.

Trademarks: Microsoft, Windows, MS-DOS, 80386, i486, ALR, FlexCache, Novell, NetWare. ©1990 Quarterdeck Office Systems

First Looks

Graftool Displays Data in 3-D

HANDS ON
by Barry Swann

Most presentation graphics packages simply don't have the oomph to satisfy users with highly technical or very large amounts of data. These users want to explore large data sets—often thousands of data points. They want to be able to generate less-common graph types, often with three-dimensional data. And they often want to be able to plot functions from a formula rather than data points. Finally, they need a package that can process and analyze data graphically as well as numerically.

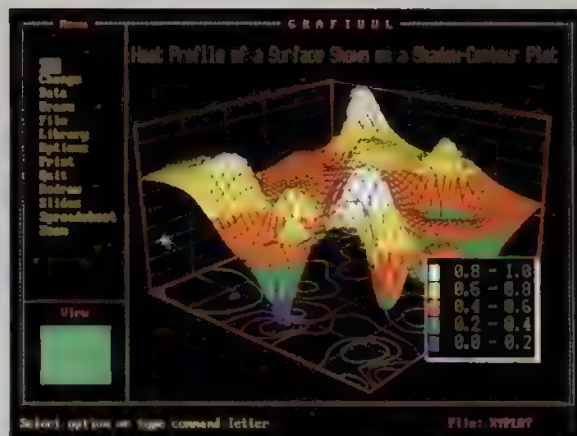
Graftool, a \$495 graphical analysis program from 3-D Visions, delivers on all accounts. Its built-in spreadsheet handles up to 4,096-by-4,096 data sets, and external ASCII data sets with millions of items in non-square arrays can be accommodated.

The program's 2-D charts include not only bar and column, pie, area, and *x,y*, but also 1-variable histograms, parametric and polar plots, scatter and vector plots. The 3-D chart types include surfaces, shadowed contour plots, trajector-

ies, 2-variable histograms, 3-D scatter, vector and stratification charts. 2-D plots include polar coordinates while 3-D plots support spherical, cylindrical and standard coordinates. It does not however support 3-D effects like shadowed pies.

The depth of options is appealing. Not only can you have multiple graphs, but each can display multiple data sets. You can even use different labeled axes on the two sides of the chart. Of course, you can add titles, labels, axis ticks, legends, and arrows. Each axis can be linear, logarithmic, or a special "probabilistic" scale in which cumulative normal distributions become straight lines. All of these options are set up and edited using simple fill-in dialog boxes.

You can import data from ASCII files, from spreadsheets in .WKS, .WK1, or .DIF format, or from a functional form. Function-building blocks include trigonometric, hyperbolic, combinatoric, and even some Bessel functions. While *Graftool* doesn't have the full analytic abilities of a *Maple* or a *MathCAD*, you can input a formula, generate data points from it, and then easily graph it.



In *Graftool* both surfaces and contour projections can portray ranges of data using color coding. The color on the surface depicts the ranges of values; the color on the contour depicts the shift in data ranges.

In addition to its graphical presentation, *Graftool* has an array of data analysis tools: three types of data smoothing, six types of regression, and several kinds of interpolation including cubic splines.

You can zoom and pan 2-D graphs and rotate 3-D graphs. With either you can use a data cursor to find the coordinates of a point on the graph. The ability to color-code contours and 3-D graphs according to ranges of values lets you focus on special data points and play visual "what ifs."

Supported output devices include LaserJets and PostScript printers, several kinds of dot matrix printers and HPGL plotters. The printed output is good but not as striking as that produced by *Gauss* or *Mathematica*.

Graftool is way ahead in terms of what it does with data, but the presentation elements and user interface lag behind. First is the nonstandard graphical interface. There's mouse support, but it's not consistent. Options are often displayed in dialog boxes with numbers you must type in rather than click on. The menu structure doesn't allow you to see where you came from. And while it's considerably better than most of the clunky scientific graphing programs on the market, the graphical interface feels somewhat dated.

Graftool's links to the out-

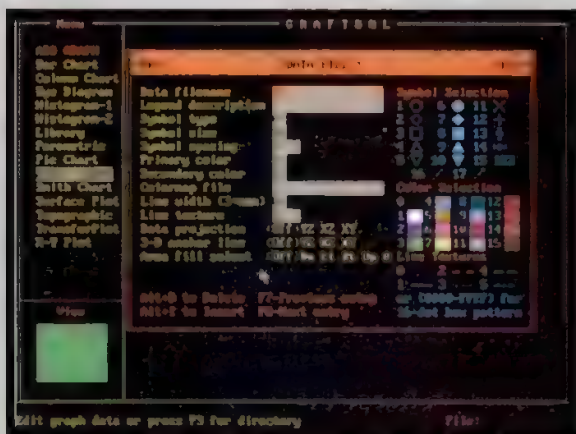
side are far from ideal. It only supports one font family per page and only uses its three supplied fonts. You can't import fonts, external graphs, or clip art. Export is limited to .EPS, HPGL, and Lotus .PIC; there's no support for either bitmapped



FACT FILE

Graftool, Version 3.0
3-D Visions, 412 S. Pacific Coast Hwy., Redondo Beach, CA 90277; (213) 540-8818.
List Price: \$495.
Requires: 640K RAM, hard disk, supported graphics monitor (Hercules monographics, CGA, EGA, VGA), DOS 3.0 or higher. Mouse and math coprocessor recommended.
In Short: Scientific graphing package with all the trimmings, including stunning 3-D graphs and a variety of data analysis tools.

CIRCLE 430 ON READER SERVICE CARD

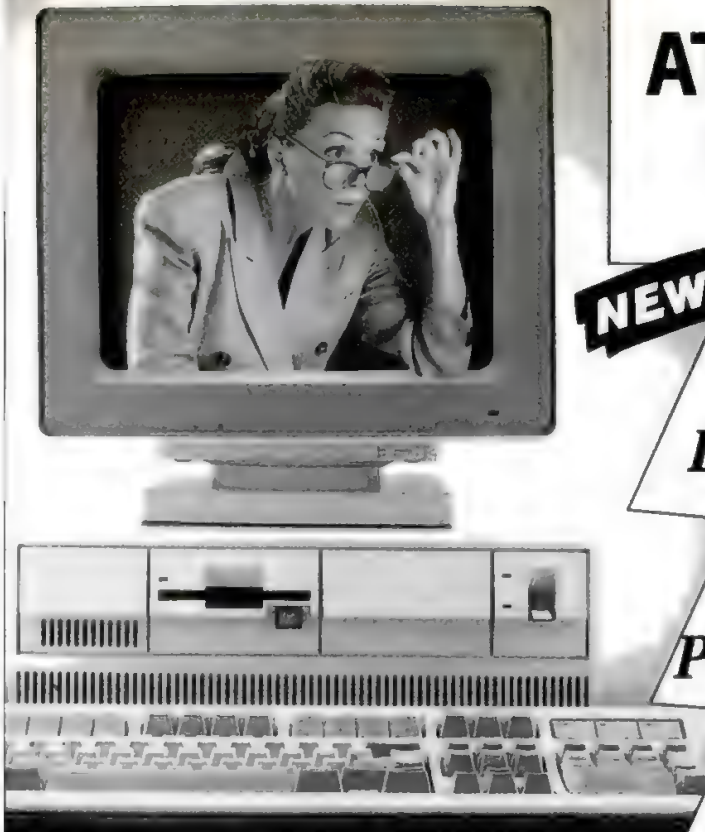


Each of *Graftool*'s 13 basic chart types has an associated fill-in dialog box to speed graph creation. Mouse or keyboard input is accepted.

AT LAST FLYP

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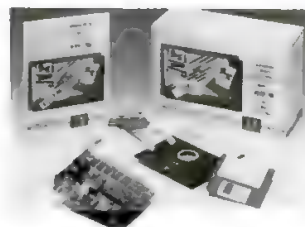
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First Looks

ConvertIt!: From HyperCard to ToolBook

HANDS ON
by Steve Rosenthal

HyperCard is the leading object-oriented hypermedia program on the Mac; Asymetrix *ToolBook* is one of a half-dozen object-oriented programs recently made available for *Windows* 3.0 on the PC.

With Heizer Software's \$99.95 *ConvertIt!*, *HyperCard* stacks can be translated to their *ToolBook* equivalents. In most cases, the end result of the conversion yields a good approximation of any graphics and buttons, an excellent transfer of character data, but an uneven and incomplete rendition of the scripts.

Still, using *ConvertIt!* is worthwhile. By doing the drudge work of moving the structure and images from a *HyperCard* stack over to *ToolBook*, *ConvertIt!* speeds up the overall translation process and ensures that the results will be similar looking on either platform. However, while the two programs will look the same, achieving similar functionality will be largely up to you and require a more manual process.

Written as the first iteration of a more-generalized translator between object-oriented hypermedia programs, *ConvertIt!* is actually a two-part program. The emitter half is a *HyperCard* stack that runs on the Mac to turn your *HyperCard* stacks into a generalized object-program description called HyperMedia Interchange File Format (HIFF). The receiver part runs as a *ToolBook* book to generate the equivalent new book from that HIFF file.

Operation of the two programs is so simple that experienced users of *HyperCard* and *ToolBook* may not even have to open the manual. On the *HyperCard* side, you pick the elements you want translated (graphics, fields, field contents,

and scripts), and the stacks you want converted. Then, you move the resulting text HIFF file over to a PC using a network, a floppy disk in a common format, or a direct serial connection.

On the PC side, you select which HIFF files to translate, and whether to run the results immediately. *ConvertIt!*'s own stack and book aren't elegant, but they are quite serviceable.

Reading the various hints and READ.ME files help you to structure your stacks for the best translation. *ConvertIt!* can't handle some types of script constructions, but those that can't be translated are brought across as extensive comments. If your scripts are complex Q or if they use any external resources such

to 50 or 60 percent.

Part of the problem is that the conversion process isn't a straight-across mapping from *HyperCard* to *ToolBook*. While they share many conceptual similarities, there's no direct *ToolBook* equivalent for many *HyperCard* features. For example, *HyperCard* stacks use bit-mapped graphics, while *ToolBook* books use vector images. Many *HyperTalk* script statements have no direct *ToolBook* OpenScript equivalent, and *HyperCard* XCMDs and XFCNs externals rarely have an exact equivalent in a *Windows* Dynamic Link Library (DLL).

Apple also claims copyright and patent rights that forbid any program except *HyperCard* from reading a *HyperCard* stack without a license; Apple says it isn't licensing programs on other platforms. Using the HIFF file sidesteps the issue but adds a layer of complexity, and increases the need for vast amounts of storage space.

The process isn't exactly lightning fast either. On the



Turning *HyperCard* stacks to *ToolBook* books is a two-step process. *HyperCard* stacks are turned into HIFF files. A *ToolBook* program makes new books from the files.

as XCMDs or XFCNs, a great deal of the work for the final *ToolBook* script must be done manually, using the comments as a guide. You can increase the proportion of code that gets translated by cleaning up your Mac files first. I found that my conversions ranged from about 20 percent to 100 percent, but most stacks were probably close

Mac, you could process between one and five elements per second using an ordinary Mac IIx. If you have a few hundred cards in a stack with a dozen fields and a few graphics per card, conversion could take the better part of an hour. Going from HIFF to *ToolBook* on a 386-based *Windows* system is only slightly faster.



FACT FILE

ConvertIt!, Version 1.0
Heizer Software, P.O. Box
232019, Pleasant Hill, CA
94523; (415) 943-7667.

List Price: \$99.95.

Requires: To use Asymetrix *ToolBook* 1.0: 2MB RAM, *Windows* 3.0. To use *HyperCard* 1.25: Macintosh with 2MB RAM.

In Short: A conversion program that turns *HyperCard* stacks into *ToolBook* books, *ConvertIt!* does a good job at translating the graphics and text elements of a stack, but often misses the functionality.

CIRCLE 438 ON READER SERVICE CARD

The current version of *ConvertIt!* will run under *HyperCard* 1.x formats, and has been tested successfully running under the prerelease versions of *HyperCard* 2.0. However, only features present in 1.x will be translated. Nor is the process bidirectional—you can't convert from *ToolBook* to *HyperCard*. An upgrade for *HyperCard* 2.0 is in the works. In the future, if there's sufficient demand, Heizer intends to supply translators for the reverse process as well as for other programs including Brightbill-Robert's *HyperPAD* and Silicon Beach's *SuperCard*.

If translating *HyperCard* stacks is a pressing issue for you, consider that there may be another alternative for running stacks on PCs: the *Plus* program from Spinnaker Software, which is already available on the Mac, is promised for delivery on *Windows*. The Mac version of *Plus* can read *HyperCard* stacks and produce a look-alike *Plus* version for both Macs and PCs. But, *Plus* requires buying a runtime version for each destination machine, whereas the *ToolBook* player comes free with *Windows*.

ConvertIt! isn't a magic incantation. In many cases, you'll get the look but not the feel of a *HyperCard* stack. Adding the functionality will be left largely to the programmer. Still, for the *ToolBook* programmer who wants to tap what's already been done in *HyperCard*, it clearly earns its keep. ■



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 **GREAT BATTERY FEATURES:** Every battery feature you want. You can plug your notebook in and "quick charge" the battery in less than one hour or you can "trickle charge" while in use. Plus your battery easily snaps out allowing the quick installation of an optional replacement battery. It's great to be able to carry a light weight spare for those especially long trips. An optional battery charger stand is available too!

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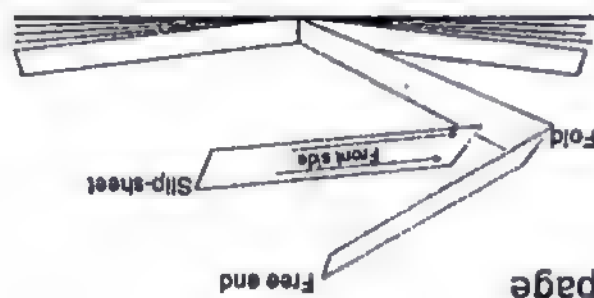
2. Insert this sheet with

1. Front side touching the free page

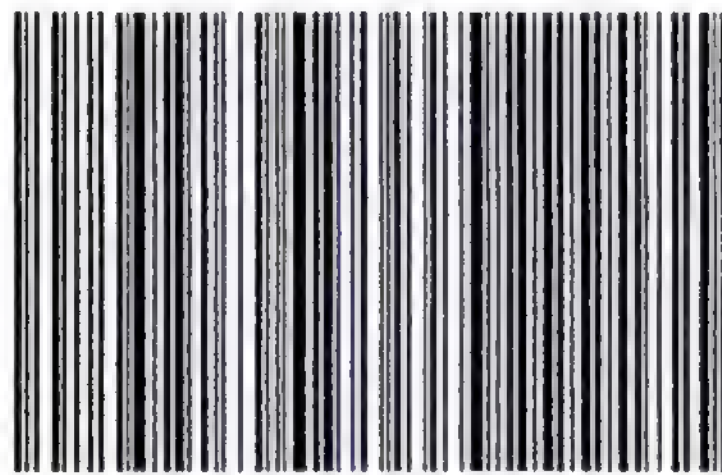
2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet



Inverted Foldout slip-sheet



GbsSlipSheet-001



Folded edge of the page

Foldout slip-sheet

1. Open the foldout page

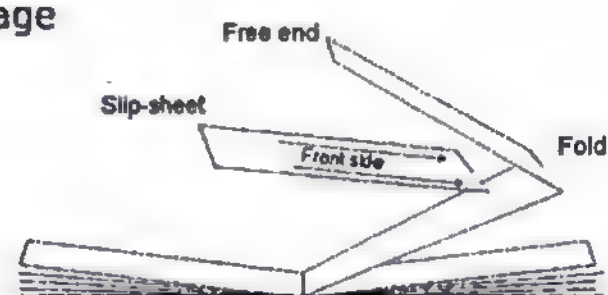
2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

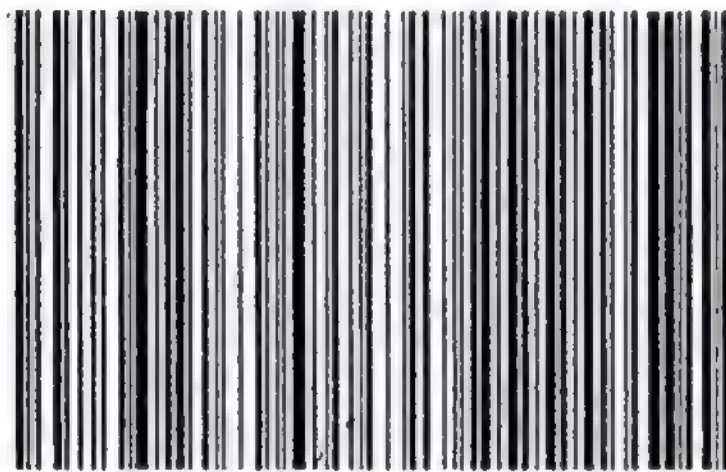
3. Slice the folded edge

4. Close the page and slip-sheet



1. Follow instructions on the other side

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Back

1. Follow instructions on the other side

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While most notebooks don't include a floppy drive at all, you're really going to appreciate your ZEOS notebook's *industry standard* 3.5" floppy. It makes loading software and transferring files a breeze. Simply toss in your 1.44 and it's done. Anyway, can you imagine a desktop system without a floppy? We couldn't either. That's why your ZEOS notebook has one. It's great!

But the features of your incredible new ZEOS Notebook don't just stop there. Detail after detail, we're giving you more than anyone else. Much more, for much less. Take a closer look.

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10 Good Reasons To Buy From ZEOS®

Reason #1

"Overall Excellence."

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These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but four times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

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PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

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Reason #7

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ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8

A Sterling Reputation.

In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

Reason #9

Easy to Buy.

ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, American Express, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

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First Looks

NoRad's Shield Eliminates Radiation and Glare

HANDS ON
by Anne E. Roberts

You've seen the news stories—computer monitors emit dangerous radiation. The NoRad Corp.'s \$129 Shield is designed to block those emissions. While there's some doubt that your monitor will kill you, there's no doubt that the Shield can protect you from some of the low-frequency signals that radiate from it. The Shield also reduces screen glare.

Like many ordinary anti-glare screens, the NoRad Shield is made from a dark mesh, but it has two major differences. The mesh is much finer, almost invisible except under the closest inspection. It is also conductive. Each strand is like a wire turned inside out—an insulating monofilament core plated with copper over nickel. The strand is finished with matte black metal fibrils that reduce glare. This ultra-fine mesh has a minimal effect on image sharpness, while it effectively stops glare.

The Shield attaches to the plastic bezel around your monitor's display tube, not to the tube itself. NoRad supplies four self-adhesive Velcro tabs to hold the screen in place, along with a packet of alcohol to clean the face of your monitor before fastening the Shield.

To eliminate radiation, the Shield must be grounded. NoRad supplies a 36-inch wire that links a snap on the lower left corner of the screen with a screw you must twist into one of the port connectors on the back of your PC. After it is grounded, the Shield almost totally eliminates low-frequency electric fields in the range above about 20 kilohertz.

In our PC Labs testing, we used a Holaday HI-3600 Survey Meter to measure the volts per meter emitted at various distances from an 8513 monitor. Measured at the screen, an unshielded monitor registered

78.9 volts per meter; the shielded monitor measured 6.27 volts per meter. At distances of more than 12 inches, no measurable radiation in the 20 kHz range could be detected with the Shield in place; without the screen, radiation was still substantial. There was no reduction in magnetic fields when the Shield was used.

NoRad offers several sizes of Shield to fit various models of monitors with screen diagonals up to 19 inches. Both rigid shields for flat-screen bezels and flexible models for curved-



The Shield's conductive mesh screen blocks glare and almost eliminates low-frequency electric fields in the 20 kHz range.

bezel monitors are available.

The Shield won't block ELF (extremely low-frequency radiation of 300 Hz and below), nor will it affect fields radiated to

the sides or rear of your monitor. ELF radiation is suspected of having a link to cancer; no commercial add-on product is currently available to protect against these effects. But, if you're concerned about fields above 20 kHz radiating from the face of your monitor, static fields and glare, the Shield will protect you. The only penalty is a slight sacrifice in screen sharpness. ■

List Price: Shield, \$129 for rigid shields from 8.38 by 7.38 inches to 12.38 by 9.5 inches; \$10 more for flexible shields; \$349 for 19-inch displays. NoRad Corp., 1549 11th St., Santa Monica, CA 90401; (800) 262-3260.

CIRCLE 432 ON READER SERVICE CARD

Plus Hardcard Picks Up Speed And Capacity

HANDS ON
by Frank Murray

You thought your 20MB hard disk was going to last forever, but now you find yourself deleting files just to run your newest software. And sometimes the disk search is so slow that you wonder if it will ever return. The Plus Hardcard IIXL promises to save you from both of these problems.

Like previous Hardcards, the IIXL functions as a regular hard disk but, instead of sitting in a drive bay and plugging into your hard disk controller, it fits into a full-length expansion slot inside your PC. The advantages to this scheme are both price and performance. If you can spare the slot, you can add another 50MB to 100MB of disk storage to your system without junking your existing hard drive.

Whether you use the Hardcard as the primary drive or as an addition to an existing drive, the installation is simple. Just plop the Hardcard into any 16-bit slot, add the device driver to your CONFIG.SYS file, then type XLINSTALL.

The installation process in-

cludes both manual and automatic procedures. The automatic installation process asks you to select the operating system and then proceeds to format your Hardcard using the largest partition allowed by your operating system. If you want smaller partitions, you can opt for the manual installation procedure and select them yourself. Utilities are available to optimize the installation for DOS, UNIX, OS/2, and Novell NetWare.

The Hardcard IIXL is an 18-millisecond IDE drive requiring no external disk controller. It features a 64K on-board memory cache and a 1:1 interleave. Our benchmark tests confirmed that the IIXL operates at around 17 ms. Plus claims that with DisCache, its integrated disk caching firmware, the Hardcard IIXLs achieve an effective access time of 9 ms. Plus also says that another cache on top of DisCache will further boost performance. We tried running Microsoft's SmartDrive with the Hardcard, and while there were no conflicts between the caches, there was also little gain in performance.

Since the Hardcard occupies a slot, it has no direct connection to the computer's LCD panel, so you can't tell when it's working. Plus gets around this problem with its LIGHT utility,

activated from the DOS command line. Whenever the Hardcard spins into action a "+" sign appears at the top right of your screen. The default setting sets this feature off, but by typing LIGHT ON or LIGHT OFF at the DOS prompt the user can toggle between modes.

The Hardcard IIXL ships in two configurations. The Model 50 is a single platter 52MB drive retailing for \$579. The Model 105 is a double platter 105MB drive and lists for \$999. Both Hardcard IIXLs are priced competitively with other 18-ms. drives.

Plus Development has made a habit out of customer satisfaction. In our Service and Reliability issue (September 25, 1990) Plus ranked highest of all hard disk manufacturers for overall customer satisfaction. With its ease of installation, its speed, and a two-year warranty, the Hardcard IIXL continues that tradition. If you need a fast-access hard drive or an additional 50MB to 100MB of disk space, the Hardcard IIXL may be your best solution. ■

List Price: Hardcard IIXL 50, \$579; Hardcard IIXL 105, \$999. **Requires:** Full-length expansion slot. Plus Development Corp., 1778 McCarthy Blvd., Milpitas, CA 95035; (408) 434-6900.

CIRCLE 704 ON READER SERVICE CARD

First Looks

Unisys Diskless Workstation Brings Aesthetics to the Office—For a Price

HANDS ON
by R. Dennis Boatner

The Personal Workstation 2 (PW2), new from Unisys, is a slice of hardware that seamlessly attaches to the back of a Unisys monitor, turning it into a diskless workstation. Less than 2 inches thick, the Novell-certified PW2 loads automatically from your network server and lets you run most applications. The PW2 comes with a 10-MHz 80286 CPU slice and a monochrome flat-screen VGA monitor. Weighing only 25 pounds, this 15- by 14- by 15-inch (HWD) package sells for \$2,495 and takes up no more space on your desktop than a

standard 14-inch monitor.

The PW2 provides an aesthetic departure from the pizza-box-style workstations that feature a plastic cover over the unused floppy drive bay. Its flat screen and professional appearance make it a welcome addition to any office. The PW2 possesses five push-button controls on the front panel (resembling piano keys) for contrast, brightness, and power. But the PW2 has a high price per features ratio, especially when compared to a conventional diskless workstation such as Earth Computer's Earthstation II, which sells for \$945 and supports any monitor from monochrome to color VGA.

The PW2 LAN workstation slice attaches at the rear of the system's display. Using a quick release docking mechanism, the PW2 redirects the network, keyboard, and power cables downward from the back of the unit. The PW2 is designed from the ground up for network connections; Unisys used surface-mount technology and careful engineering to cram many features into a small package.

Inside the slice, the PW2 has an optional 80287 math coprocessor slot, a 10-MHz 80286 processor, and 1MB of RAM (expandable to 5MB using SIMMs). Remember, the PW2's processor isn't slowed down by interrupts from I/O boards because there are no expansion slots. On the *PC Magazine* benchmark tests, the PW2 nearly matches the 12-MHz Compaq Deskpro 286e, with a 6.24 80286 Instruction Mix time, compared to Compaq's 6.11 second score.

The PW2 uses a standard 101-key keyboard with 12 func-

tion keys and separate numeric and cursor pads. Unisys also includes a 9-pin RS-232-C port, a parallel port, a 10-megabit-per-second Ethernet LAN adapter with a 15-pin AUI connector, and a 6-pin mini-DIN mouse port. The Phoenix system ROM BIOS supports MS-DOS 4.01, *Microsoft Windows* and *Novell NetWare* 286/2.1 or later. This unit interacts with Unisys 1100/2200 Series mainframes, A and V Series hosts, and System 80 computers.

The Unisys Personal Workstation 2 provides a professional-looking diskless PC. The price may be high, but its small size, silent operation, and *NetWare* certification give it appeal to end users and system administrators alike.

List Price: Personal Workstation 2, \$2,495.

Requires: *Novell NetWare* 286, Version 2.1 or above. Unisys Corp., 2700 N. First St., P.O. Box 6685, San Jose, CA 95150-6685; (408) 434-2848.

CIRCLE 708 ON READER SERVICE CARD

AUTOCON Shareware Manages AUTOEXEC/CONFIG

HANDS ON
by Salvatore P. Riccardi

Most power users are used to making occasional changes to their DOS boot files, *AUTOEXEC.BAT* and *CONFIG.SYS*. If you have TSRs, system programs, or device drivers that you don't want loaded all the time, you're probably already maintaining multiple sets of boot files. *AUTOCON*, an \$18 shareware program, lets you create and maintain a database of *AUTOEXEC/CONFIG* combinations so that you can quickly and easily change configurations.

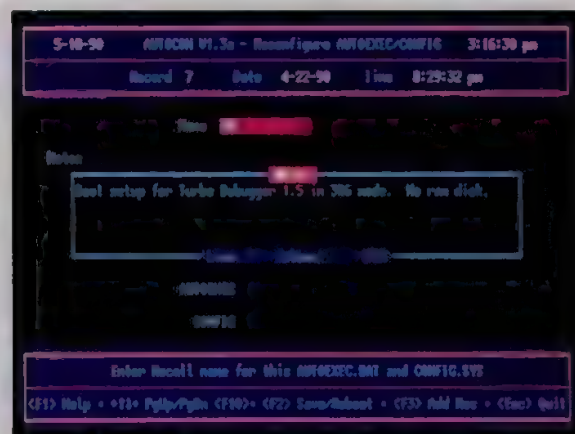
AUTOCON holds up to 50 records in its database, with each record containing one *AUTOEXEC/CONFIG* combination. You can page through each record in the database and reboot using the on-screen configuration at the touch of a key.

You can assign each record a familiar name, and reboot using the named configuration. For example, if you name your boot

set WIN3 because you've customized it for *Microsoft Windows*, you can reboot by typing *AUTOCON WIN3* at the command line.

To reboot your computer, *AUTOCON* replaces your current *AUTOEXEC.BAT* and *CONFIG.SYS* files with those in the named record and then reboots your machine. This means that when you make changes to your *AUTOEXEC* or *CONFIG* files outside of *AUTOCON*, you'll have to remember to make them inside of *AUTOCON* as well. Generally speaking, you should make all changes inside *AUTOCON* and reboot from there. Otherwise you'll run the risk of wiping out any changes made between *AUTOCON* sessions.

A built-in full-screen editor lets you change each record's *AUTOEXEC* and *CONFIG* entries. The editor uses *WordStar*-like keystrokes and is quite capable. You can redefine the editor keys using a pop-up keystroke editor.



AUTOCON maintains a database of *AUTOEXEC/CONFIG* combinations and lets you page through each record. It includes a text editor.

If you're using a disk cache, you can tell *AUTOCON* to issue your disk cache's Flush command prior to rebooting. This is important if your cache uses delayed writes, since changes made in *AUTOCON* may otherwise not be written to disk.

AUTOCON is an easy-to-use and affordable solution to maintaining multiple boot configurations. Similarly priced alterna-

tives to *AUTOCON* are *PC Magazine's* own *CONFIG.CTL* and *BOOT.SYS* (see "BOOT.SYS," First Looks, *PC Magazine*, July 1990), another shareware offering.

List Price: *AUTOCON*, Version 1.3a, \$18. **Requires:** 256K RAM, DOS 2.0 or later. Larry Weaver, P.O. Box 2639, Weaverville, CA 96093-2639; (916) 623-5045.

CIRCLE 709 ON READER SERVICE CARD

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CIRCLE 218 ON READER SERVICE CARD

Specifications are subject to change without notice.

by
Rink Murray

New & Improved

News of Announced Products and Upgrades

New-to-Market Printers from Various Vendors Arrive in Time for Comdex

NEW

Several manufacturers announced printers after the testing deadline for this year's *PC Magazine* printer issue. They follow below in alphabetical order.



AccuPrint LaserCheck

AccuPrint's LaserCheck is a low-cost 6-ppm laser printer designed for business check printing. Featuring Magnetic Ink Character Recognition (MICR) printing capabilities required by banks' automatic sorting equipment, 512K memory upgradable to 4MB, and full compatibility with Hewlett-Packard's HP LaserJet II, the LaserCheck also supports an optional printer-based audit trail that tracks all MICR printing for up to 10,000 checks, forms-control software, and logo/signature digitization services. To ensure the integrity of MICR printing, LaserCheck automatically controls the signal strength applied to the MICR characters regardless of the contrast settings of the rest of the page.

List Price: LaserCheck, \$2,995. AccuPrint Inc., 5235 Avenida Encinas, #A, Carlsbad, CA 92008; (619) 931-9316.

CIRCLE 441 ON READER SERVICE CARD



Panasonic KX-P4455 Laser Partner

Panasonic enters the PostScript market with the \$3,495 KX-P4455 Laser Partner, promising 11-page-per-minute PostScript output at 300 dots per inch. The KX-P4455 features 2MB of RAM (expandable to 4MB), 39 resident fonts, a built-in font card slot, plus 26 internal fonts when in Hewlett-Packard mode. Standard interfaces include Centronics parallel, RS-232C/422A, and AppleTalk. HP LaserJet Series II and Diablo emulations are standard.

List Price: KX-P4455 Laser Partner, \$3,495. Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094; (800) 742-8086 or (201) 348-7000.

CIRCLE 442 ON READER SERVICE CARD



Seiko ColorPoint PS

Seiko's ColorPoint PS Series promises fast color output and PostScript compatibility for under \$10,000. Based on the Intel 80960 RISC microprocessor, the ColorPoint PS features the PhoenixPage PostScript Printer Language Interpreter. The Model 4 is an A-sized (8.5 by 11) printer with 6MB RAM, and the Model 14

CONTINUES ON PAGE 56



The \$3,495 Panasonic KX-P4455

NCR Unveils Its Wireless Network

NEW

NCR Corp. introduces a wireless LAN that it claims can transmit data at 2 million bits per second. To ensure data integrity, the NCR WaveLAN features spread-spectrum radio frequency technology and offers an optional encryption security feature. Each WaveLAN node occupies a 16-bit expansion slot in the PC and is outfitted with an omnidirectional antenna. WaveLAN operates within a radius of 800 feet in an open or semiopen office area and connects to conventionally wired networks.

List Price: WaveLAN, \$1,395 per workstation; DES security feature, \$90. NCR Corp., 1700 S. Patterson Blvd., Dayton, OH 45479; (513) 445-5000.

CIRCLE 438 ON READER SERVICE CARD

HOT PROSPECT

HIGH-END CAD FROM THE OTHER SIDE

Ashlar Vellum, the popular Macintosh CAD package, now works under *Microsoft Windows 3.0*. Vellum's intelligent Drafting Assistant helps the user align geometric objects during the drawing process. As you move the cursor around the screen, the program identifies endpoints, midpoints, arc and circle centerpoints, intersections, tangencies, and perpendiculars. Furthermore, Vellum's Integrated Parametrics permit you to draw without worrying about exact dimensions. Once a drawing's shape and alignments are set, you can specify the dimensions, and the program updates the drawing.

List Price: Ashlar Vellum, \$1,995. **Requires:** 4MB RAM, an 80386 processor, *Microsoft Windows 3.0*, and DOS 3.1 or later. Ashlar Inc., 1290 Oakmead Pkwy., Sunnyvale, CA 94086; (408) 746-3900.



Vellum finds intersections for you.

CIRCLE 437 ON READER SERVICE CARD

Marconi, The Almost Wireless Solution

NEW

GEC-Marconi Software Systems has begun shipping a cable-free peripheral-sharing device. Roughly the size and shape of a portable CD player, the Verran AC DataLink and DPS (Dedicated Printer Sharer) let your PC talk to any peripheral or terminal through the building's AC circuitry. When connected to a printer, the AC DataLink and DPS act as a print spooler that can handle multiple print jobs from up to seven PCs. The DataLinks connect with either serial or parallel ports, they operate independently of the operating system, and

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New&Improved

Printers

CONTINUED FROM PAGE 55

is a B-sized (11 by 17) printer with 10MB RAM. Both units print at 300-dpi resolution, support Adobe Type 1 fonts, and include 35 standard fonts, one Centronics parallel, one serial, AppleTalk, and two SCSI ports.

List Price: ColorPoint PS Model 4, \$6,999; ColorPoint PS Model 14, \$9,999. Seiko Instruments, USA Inc., Graphic Devices and Systems Division, 1130 Ringwood Ct., San Jose, CA 95131; (408) 922-5800.

CIRCLE 443 ON READER SERVICE CARD



Star Micronics Multi-Font Series

Star Micronics adds four low-cost dot matrix printers that feature a limited two-year warranty. The NX-2420 Rainbow color printer and the NX-2420 Multi-Font are 24-pin printers with seven resident fonts, print speeds up to 250 characters per second, and switchable push/pull tractor feeds. The NX-1001 Multi-Font is a small-footprint 9-pin push-tractor dot-matrix printer with five resident fonts, and the NX-1020 Rainbow color printer offers the printing speeds and paper-handling functions of its 24-pin brethren, but with 9-pin output.

List Price: NX-2420 Multi-Font, \$499; NX-1001 Multi-Font, \$249; NX-2420 Rainbow, \$549; NX-1020 Rainbow, \$320. Star Micronics America Inc., 420 Lexington Ave., #2702, New York, NY 10170; (212) 986-6770.

CIRCLE 444 ON READER SERVICE CARD

Marconi

CONTINUED FROM PAGE 55

they require no software other than their built-in firmware. AC DataLinks adhere to the FCC Class B standard and have security features that allow users to encrypt all data as it's sent over the wires.

List Price: AC DataLink, \$345; AC DataLink and DPS, \$395. GEC-Marconi Software Systems, 12110 Sunset Rd., #450, Reston, VA 22090; (703) 648-1551.

CIRCLE 430 ON READER SERVICE CARD



The Marconi DPS

Dell, NEC, Philips Ship New Systems

NEW



Dell System Series

Dell Computer Corp. announces a 20-MHz 386SX portable. The 320LT features 1MB of RAM (expandable to 8MB), a 3.5-inch high-density disk drive, a detachable backlit supertwist VGA display, parallel and serial ports, ports for an external monitor and keyboard, a 20MB hard disk, a dedicated slot for the Dell Data/Fax 9,600-bit-per-second modem, and a half-sized 8-bit slot. Weighing 15 pounds, the 320LT includes two 2-hour nickel cadmium batteries, and an AC adapter.

Broadening its high end, Dell introduced the System 425TE and the 433TE, two floor-standing EISA 80486-based computers running at 25 and 33 MHz respectively. The 425TE and 433TE feature Dell's Drive Array mass storage option, which Dell claims improves performance and readability. Both units feature 4MB of RAM expandable to 64MB on the motherboard, integrated 16-bit 1,024-by-768 resolution VGA video, 3.5- or 5.25-inch high-density floppy disk drives, and eight EISA expansion slots. The systems can support a maximum of 1.6GB.

List Price: Dell System 320LT with 1MB RAM, 20MB hard disk, \$3,599. System 425TE with 4MB RAM, 80MB hard disk drive, and VGA monochrome monitor, \$6,749; System 433TE, \$8,949. Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759-7299; (800) 426-5150.

CIRCLE 445 ON READER SERVICE CARD

Affordable Network Analysis For OS/2

NEW

ProTools' graphical network analysis tool, the Protolyzer, exploits the abilities of Intel's 80386 microprocessor technology and Microsoft's OS/2 Presentation Manager icon-based interface to provide users with comprehensive network analysis tools that help optimize and repair LANs. Beyond protocol analysis, the Protolyzer provides icons to let even nontechnical users control the flow of information through the network, acquire data, filter data, customize reports and displays, file data, and transmit data in real time. The Protolyzer also contains DDE to integrate data with *SQL Server* and *Microsoft Excel*; a built-in compiler and forms generator allow end users to customize monitoring and reporting functions.

List Price: The Protolyzer, \$14,995.

Requires: 8MB RAM, OS/2 1.2 or later.

ProTools Inc., 14976 NW Greenbrier Pkwy., Beaverton, OR 97006-5733; (503) 645-5400.

CIRCLE 440 ON READER SERVICE CARD



The NEC UltraLite 286V has a 20MB hard disk.



NEC UltraLite 286V, ProSpeed SX/20

NEC Technologies throws another notebook into the ring. Measuring 1.7 by 12.2 by 9.5 (HWD), the 6.5-pound UltraLite 286V features a 12-MHz 286V processor, 1MB of RAM (expandable to 5MB), a 10-inch backlit VGA LCD, an external 3.5-inch high-density disk drive, two 2.5-hour nickel cadmium batteries, serial, parallel, and external VGA video ports, and a 20MB hard disk. Expansion includes one memory expansion slot and a dedicated fax/modem slot.

The 13-pound ProSpeed SX/20 is a 20-MHz 386SX laptop that converts to a desktop PC when used in conjunction with NEC's Docking Station. Measuring 3.4 by 10.6 by 13.4 (HWD), the ProSpeed SX/20 features 1MB of RAM that's expandable to 5MB, a 40MB hard disk, a 3.5-inch 1.44MB disk drive, a backlit monochrome VGA display, a 3-hour battery, serial, parallel, and RGB video ports, an RJ-45 port, numeric keypad port, and an internal modem slot. The Docking Station retails for \$1,199 and features two 16-bit expansion slots, two serial ports, one parallel port, one RGB connector, and two RJ-11 connectors.

List Price: NEC UltraLite with 1MB RAM, 20MB hard disk, external 3.5-inch high-density disk drive, \$3,999. NEC ProSpeed SX/20 with 1MB RAM, 40MB hard disk, \$5,999. Docking Station, \$1,199. NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191; (708) 860-9500.

CIRCLE 446 ON READER SERVICE CARD



HeadStart 500, 500CD

Philips Consumer Electronics introduces a slew of new 16-MHz 386SX PCs featuring substantial software bundles. The HeadStart 500 is a 16-MHz 386SX processor, with 1MB RAM, an 18-ms. 80MB hard disk drive, 16-bit VGA graphics, a mouse,

CONTINUES ON PAGE 58



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CIRCLE 287 ON READER SERVICE CARD

Code: MX83

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New&Improved

Computers

CONTINUED FROM PAGE 56

game port, and internal 2,400-bit-per-second modem. Software includes DOS 4.01, *HeadStart Environment*, *Quattro*, *Q&A*, *Publish-It!*, *Deluxe Paint II*, *Word for Word Professional*, and *Prodigy*. The HeadStart 500 CD also boasts a built-in 680MB CD-ROM drive. CD-ROM software included is *Microsoft Bookshelf*, *Grolier Encyclopedia*, and *PC Globe*. The MAXStation 386SX (without modem) and Magnavox Magnum SX ship without CD-ROM drives and with only Alphaworks integrated software.

List Price: HeadStart 500 with 1MB RAM, one 3.5-inch and one 5.25-inch high-density floppy disk drive, 80MB hard disk drive and 2,400-bps modem, and DOS 4.01 and bundled software, \$2,499; HeadStart 500 CD with 680MB CD-ROM drive, \$2,999; MAXStation 386SX, \$2,399; Magnum SX, VGA monitor, \$2,799; VGA monitor, \$499. Philips Consumer Electronics Co., One Philips Dr., P.O. Box 14810, Knoxville, TN 37914; (615) 521-4499.

CIRCLE 447 ON READER SERVICE CARD

Software Print Spooling

NEW

BLOCPublishing's *PrintRite* print spooler has the ability to spool up to five printers and 255 print jobs simultaneously. Working as a memory-resident program, *PrintRite* compresses data, then spools it to disk. *PrintRite* then uses time-slicing to manage the queue of print jobs, thus freeing up the processor for other activities. *PrintRite* features pull-down menus and help screens, queuing and spooling displays, the ability to group jobs, user-definable hotkeys, and the ability to pause and restart jobs.

List Price: *PrintRite*, \$99.95. **Requires:** 50K RAM, DOS 2.0 or later. BLOCPublishing, 800 Douglas Entrance, Executive Tower Penthouse, Coral Gables, FL 33134; (800) 955-1888, (305) 445-0903.

CIRCLE 448 ON READER SERVICE CARD

Remote-Control Network, The Invisible Helping Hand

NEW

Invisible Software's *Invisible NET Control* is a remote-control program that works with any NetBIOS-compatible network. Ideal for classroom or training environments, *Invisible NET Control* permits a user to monitor or observe another user's screen. Other features include group broadcasts, two-way chat, and remote

control of other workstations. Also, operating in CGA, EGA, and VGA modes, *Invisible NET Control* lets users send text or graphics screens to other users.

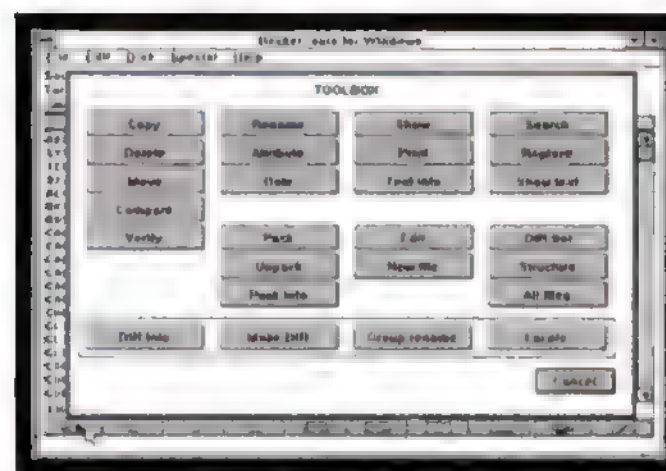
List Price: *Invisible NET Control*, \$279 per network site. **Requires:** 30K RAM per workstation, DOS 3.1 or later. Invisible Software Inc., 1142 Chess Dr., Foster City, CA; (415) 570-5967.

CIRCLE 449 ON READER SERVICE CARD

File Management for Windows 3.0

NEW

Abacus introduces *BeckerTools for Windows*, a new software utility that brings file and data management directly into the Windows 3.0 environment. With *BeckerTools*, users no longer have to shell out to DOS to access commands like Copy, Delete, Move, Compare, Verify,



Under Windows 3.0 *BeckerTools* puts file management just a click away.

Rename, Attribute, Date, Pack, Unpack, Make Directory, Search, Format, and many more.

List Price: *BeckerTools for Windows*, \$79.95. **Requires:** Microsoft Windows 3.0, and DOS 3.1 or later. Abacus, 5370 52nd St. SE, Grand Rapids, MI 49512; (616) 698-0330.

CIRCLE 450 ON READER SERVICE CARD

IMPROVED

QEMM, Version 5.1—Quarterdeck Office Systems' expanded memory manager is poised to exploit Microsoft Windows 3.0's weaknesses. Microsoft Windows does not make high memory available when operating in standard or enhanced mode. *QEMM*, Version 5.1, now allows Windows 3.0 users to load TSR (terminate and stay resident) programs, drivers, and DOS resources into high memory no matter which mode (real, standard, or enhanced) Windows is running in. *QEMM*, Version 5.1, retails for \$99.95, with upgrades now available for \$40 from Quarterdeck Office Systems in Santa Monica, Calif. at (213) 392-9851.

FormFiller, Version 3.0—BLOCPublishing stacks new features into its forms creation and filling package. Version 3.0 can handle 640 data fields and features a menu-driven interface, full on-line help, user-defined help fields, improved data entry and validation, improved copy, move, delete, and erase functions, and support for the entire LaserJet series. Version 3.0's design commands are performed by keystrokes rather than command strings. Version 3.0 also includes standard defaults to help users with their template designs. *FormFiller*, Version 3.0, retails for \$149, and upgrades are available for \$39 from BLOCPublishing in Coral Gables, Fla. at (800) 955-1888 or (305) 445-0903.

PowerForms, Version 2.0—Previously called *Forms Express*, *PowerForms* 2.0 from g4 now combines ready-to-use customizable forms with a dBASE-compatible relational database. Offering 20 generic forms for everything from packing lists to expense reports and sales orders, Version 2.0 also includes automatic data entry error checking, calculated fields, automatic file and index creation/maintenance, pick list data entry, on-line help, dBASE and ASCII data import/export, and the ability to import .PCX image files. *PowerForms*, Version 2.0, retails for \$139.95 or for \$45 when upgrading from any forms package. Contact g4 in Redondo Beach, Calif. at (213) 536-0937.

EiconScript 200 and 300—Eicon Technology's PC-resident PostScript printer controller cards use the RISC Intel 80960 architecture at 20 and 25 MHz. EiconScript 200 and 300 controllers support and promise to double the horizontal resolution of all HP LaserJet Series II and Series III printers, and most printers with Canon laser engines. The EiconScript 200 and 300 provide foreground/background processing through direct access to the hard disk, work with Windows 3.0, and support PCL4 emulation. EiconScript 200 and 300 operate at four menu-selectable resolutions (300 by 300, 600 by 300, 400 by 400, 800 by 400). EiconScript 200 retails for \$1,995 and EiconScript 300 retails for \$2,295. For upgrade rebates contact Eicon Technology in Montreal, Quebec, Canada at (514) 631-2592.

Arlan—Telesystems' wireless network now supports Novell NetWare 386. Arlan, which uses network cards, antennas, and spread spectrum technology to communicate among PCs, can even be used as an Ethernet bridge between servers in different buildings. For more information on Arlan, see the *PC Magazine*, May 29, 1990, issue where Arlan won Editor's Choice in our wireless LAN round-up. Arlan 450 lists for \$1,500 from Telesystems SLW Inc. in Don Mills, Ontario, Canada, and can be reached at (416) 441-9966.

Primavera introduces some important new project management terminology.

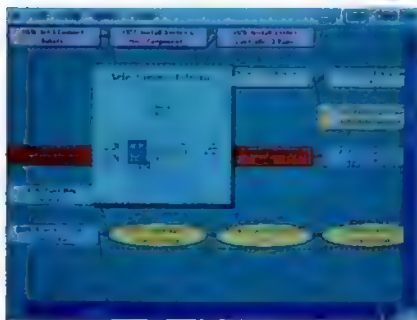
POP!

ZOOM!

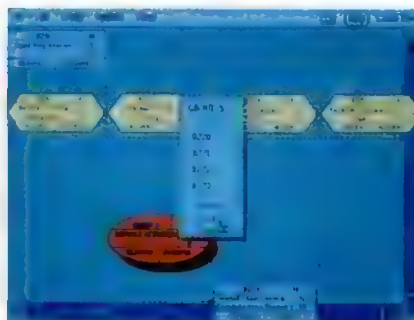
CLICK!

EXPLODE!

Click-Click—use double clicks to add activities, define relationships, and modify activity data.



Zoom — five levels of detail for your network, from bird's-eye to close-up.



Explode — The Collapse command compresses several activities into one; Explode redisplay activities in their original positions.



Pop — highlights all predecessor-successor relationships and lets you click your way along any activity path.

Primavera Project Planner® 4.0 works like you think. Visually. Graphically. Intuitively. As quickly as "pop", "click", "zoom"! Keeping you in touch with the big picture while giving you instant access to all the details.

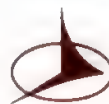
Create an activity? Point, click-click.
Define a relationship? Two clicks and done.
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New&Improved

Forms Package for Windows 3.0

NEW

FormWorx Corp. announces *Form Publisher for Windows*, a desktop publishing program specifically designed for creating forms. The program includes *Forms-on-Demand's* collection of 600 standard industry, business, and government forms. Users can place and wrap text of any style or size and import scanned images. Other features include automatic text formatting, bar codes, and support for color printers. *Form Publisher for Windows* is compatible with HP LaserJet printers, and the user can even store the program's macros in the LaserJet's memory.

List Price: *Form Publisher for Windows*, \$249. **Requires:** 640K RAM, Windows/286 or later, DOS 3.1 or later. FormWorx Corp., Reservoir Pl., 1601 Trapelo Rd., Waltham, MA 02154; (800) 992-0085, (617) 890-4499.

CIRCLE 700 ON READER SERVICE CARD

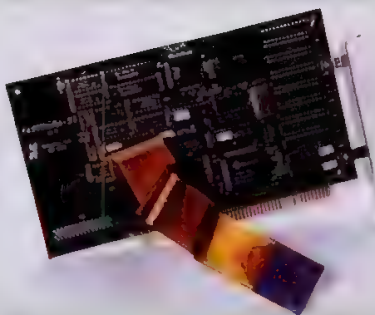
Database Atlas Package Generates Strategic Maps for Businesses

NEW

Designed for businesses that need to understand and present geographic data, Strategic Mapping introduces *Atlas*GIS*—a full-featured, integrated, desktop geographic information system (GIS). *Atlas*GIS* combines its advanced mapping capabilities with a built-in database manager. Users can create geographic files from paper maps used in conjunction with a digitizing tablet, or edit existing geographic files and create multiple layers by grouping features in a single geographic file. *Atlas*GIS* reads and writes standard *dBASE* files, and the built-in database manager lets you enter, display, edit, query, and print any data in your attribute or data point file using commands similar to *dBASE III Plus*. *Atlas*GIS* also contains a number of presentation graphics tools and fonts which let the user customize maps and design frames, legends, titles, scale bars, and insets. Also available from Strategic Mapping is a full library of data files with modules ranging from Postal or Census Geography to Advertising regions, highway networks, and point locations of banks and shopping malls. **List Price:** *Atlas*GIS*, \$2,495. **Requires:** 640K RAM, DOS 3.0 or later. Strategic Mapping Inc., 4030 Moorpark Ave., #250, San Jose, CA 95117; (408) 985-7400.

CIRCLE 701 ON READER SERVICE CARD

IMPROVED



For \$595 the FASTCache-SX will turn your 286 into a 20-MHz 386SX.

Go memory boards. The *GoScript* software includes 13 scalable fonts for use with most applications which support PostScript output. LaserGo boards are compatible with HP LaserJet Series IIP and III, and ship standard with 1MB RAM upgradable to 4MB. LaserGo with *GoScript* retails for \$295 from LaserGo Inc. in San Diego, Calif. at (800) 955-1132 or (619) 450-4600.

1-2-4 Plus with PacificPage PostScript—Pacific Data Products now bundles its PacificPage PostScript emulation cartridge with its 2MB (upgradable to 4MB) 1-2-4 Plus upgradable memory board for use with HP LaserJet Series II printers. PacificPage gives users access to 35 scalable fonts, and provides full PostScript, Version 51.9, capabilities, including reversed text, scaled fonts, text rotation, and complex graphics.

Pacific 4 Memory are upgradeable cards which allow users to expand the Hewlett-Packard LaserJet IIP's standard 512K printer memory or the standard 1MB memory of the LaserJet III by either 1, 2, 3, or 4MB. Pacific 4 Memory cards range in price from \$199 for the 1MB version, to \$499 for the 4MB version.

Pacific Data Products also announces Pacific T Memory, an upgradeable memory board for any laser printer which uses TEC laser engines—including Epson, Toshiba, AT&T, NCR, Mannesmann Tally, and Packard Bell. The Pacific Ts expand TEC memory from 512K to either 2MB or 4MB and come with a lifetime warranty. The 2MB 1-2-4 Plus Memory Board with PacificPage cartridge retails for \$499. The Pacific T Memory 2MB version costs \$399, and the 4MB version is \$699. Contact Pacific Data Products Inc. in San Diego, Calif. at (619) 552-0880.

TreeSaver, Version 2.0—Discoversoft knows how to get more out of your laser printer while doing some good for the environment. When you download soft fonts into your Hewlett-Packard laser printer, *TreeSaver* intercepts them and algorithmically changes their size according to your needs. *TreeSaver* can reduce fonts to less than four points, and can even shrink graphics when combined with text. This kind of shrinkage is perfect for users who want to print to Filofax-sized paper or get two pages or more on each sheet. *TreeSaver*, Version 2.0 retails for \$89.95. Contact Discoversoft Inc. in Alameda, Calif. at (415) 769-2902.

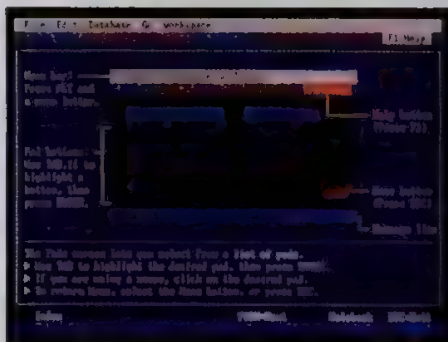
HyperPAD, Version 2.0—Brightbill-Roberts' text-based object-oriented environment for managing, customizing, and launching applications now has improved pull-down menus and a hypertext on-line tutorial to help users design and use pads. With the click of the mouse *HyperPAD* can launch DOS and Windows 3.0 programs with their associated work files.

Other new features include a new pad for Novell networks, the ability to launch a data file and application with a single click, support for the LIM (Lotus/Intel/Microsoft) EMS 4.0 specification, an enhanced DOS shell for managing files and directories, an improved time planner, a phone pad system that manages phone contacts and prints forms and labels, and over 50 new PADtalk commands and functions. *HyperPAD*, Version 2.0, retails for \$149.95 with a \$30 upgrade from Brightbill-Roberts in Syracuse, N.Y., at (315) 474-3400.

CONTINUED FROM PAGE 58

FASTCache-SX, Version 1.3—Microway's newest accelerator will transform your 286 into a 20-MHz 386SX. The FASTCache-SX fits into any 16-bit slot in your 286, and its cable plugs into the CPU socket on the motherboard. Version 1.3 promises an increase of speed from 4 to 8 times the original throughput of your AT. At \$595, the FASTCache-SX is an inexpensive way to upgrade to 386 processing power. FASTCache-SX 20-MHz retails for \$595 from Microway in Kingston, Mass. at (508) 746-7341.

LaserGo with GoScript—LaserGo now bundles its PostScript-language interpreter with its Laser-



HyperPAD's new context-sensitive help leads through each screen's features.



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From PC Magazine, Volume 9, #14 pages 175 & 176



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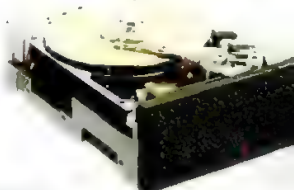
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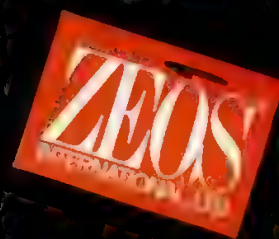
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edited by
Matthew J. Ross

Read Only

Reviews of the Latest Books for the PC User

Three for Windows 3

Microsoft estimates that it will sell two million copies of *Windows 3.0* this year, so it's no surprise that *Windows 3.0* books are proliferating, too. Here are three new titles for all audiences, from novices to power users.

■ *Windows 3 Made Easy*

by Tom Sheldon

Osborne McGraw-Hill, \$19.95

At 470 pages, this book is only slightly thinner than the other two more-costly volumes, which run at just over 500 pages. This book walks methodically



through the standard features with a look at how a typical user might use *Win 3* to organize work. The

advanced section includes information about *Windows* real, standard, and enhanced modes, and appendices cover such topics as how to optimize your installation, use the scientific calculator, and work better with networks.

Unfortunately, *Windows 3 Made Easy* isn't as easy on the reader as it might be. The book has a strike against it before you even read a word—it appears to have been produced with a 300-dpi laser printer, and the “jaggies” on the text are quite evident. Many of the screen shots are blurry, and the presentation suffers as a result.

Appearances may be secondary to substance, but the content of *Windows 3 Made Easy* falls short as well. The writing style is slow with many backward and forward references; you are constantly tempted to jump back and forth between chapters. There's not

enough information on optimizing your *Windows* configuration or the extensive Help facilities, and the relatively frequent typos and misstatements of fact might cause some confusion.

Osborne McGraw-Hill, 2600 Tenth St., Berkeley, CA 94710; (800) 227-0900
ISBN: 0-07-881537-1

CIRCLE 306 ON READER SERVICE CARD

■ *Windows 3 Companion*

by Lori L. Lorenz and R. Michael O'Mara
Microsoft Press, \$27.95

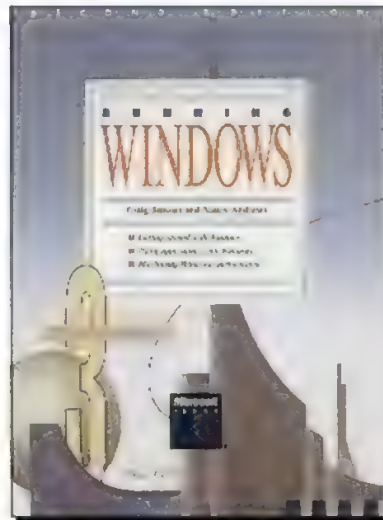
Lori Lorenz and Michael O'Mara are part of the Cobb Group, which is well known for its many best-selling computer books over the years. The quality of that experience shows clearly in *Windows 3 Companion*. The book is beautifully produced—the layout is functional with marginal notes for efficient skimming, the typography is crisp, and the artwork is clear and easy to understand.

The content is organized and accessible. Most installation advice comes in an appendix, so you can move directly into the meat of the book. The first chapter runs quickly through the high points of *Win 3*, its installation, and it teaches you how to run your first session. The middle sections focus on the general features of the environment, and there is even an extensive section on using *Win 3*



with a network, a must for LAN administrators. The rest of the book covers advanced

Windows modes, memory, and how to optimize non-*Windows* applications. The best comes last: cutout quick reference cards for the bundled *Win 3* applications, and comprehensive menu maps showing all the menu and submenu options.



Running Windows gives power users the methods necessary to customize the *Win 3* interface.

Windows 3 Companion avoids highly technical issues such as changing the *WIN.INI* configuration file, but covers the basics thoroughly with some useful shortcuts. It's an excellent reference featuring dozens of live examples of how different functions work.

Microsoft Press, 16011 NE 36th Way, Box 97017, Redmond, WA 98052-6399; (800) 677-7377
ISBN: 0-936767-19-7

CIRCLE 307 ON READER SERVICE CARD

■ *Running Windows, Second Edition*

by Craig Stinson and Nancy Andrews
Microsoft Press, \$24.95

Running Windows: Second Edition by Craig Stinson and Nancy Andrews is also published by Microsoft Press. The title might make you think this is a warmed-over rehash of an earlier edition, but a look inside quickly dispels those fears.

The organization is quite similar to that used in *Windows 3 Companion*, but the approach is quite different. *Running Windows* does not skirt a subject,

but instead dives right in, offering dense and detailed information. Handy tips are liberally sprinkled throughout; they are set off in boxes or flagged with an icon which shows whether they apply to mouse or keyboard actions, or to *Win 3* as a whole.

Running Windows is all business. While the other two books offer some explanation of Solitaire and Reversi—the two games bundled with *Win 3*—*Running Windows* barely mentions their existence. This book offers information on technical details such as fine-tuning options in the

WIN.INI file. It is also the only one to discuss major third-party *Windows 3.0* applications in significant detail.

Running Windows contains the most thorough details on the various topics, but it's also a little more difficult to apply since there are fewer examples using “live” data. However, the typography and illustrations are excellent, and while the writing style may not exactly sweep you away, the text is clear and concise.

Microsoft Press
ISBN: 1-55615-272-8

CIRCLE 308 ON READER SERVICE CARD

All three books offer advantages over the Spartan text supplied in Microsoft's *Win 3* manuals, but for general tips and information, *Windows 3 Companion* is your best bet. If you want in-depth coverage for fine-tuning your configuration, then read *Running Windows*—its detailed explanations will save you much more time than it takes to read it.

—Alfred Poor

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CIRCLE 219 ON READER SERVICE CARD

by
Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

AMD Packs an Entire PC's Logic Onto a Single Chip

Advanced Micro Devices has been a company in eclipse the last two years.

AMD grew to prominence with a technology-sharing agreement with Intel in the early '80s that gave AMD the right to manufacture and sell the 286 chip. The company's fortune changed, however, when Intel refused to turn over the masks for the 386 chips in '86. Intel still continues to claim that the technology sharing is over.

Meanwhile, both Chips and

Technologies Inc. and Cirrus Logic were building reputations as leading designers of peripheral logic devices.

A merger with Monolithic Memories in 1987 did little to stem the erosion of AMD's market share.

And when Harris entered the 286 market, AMD seemed to be on the ropes; the PC manufacturers who had been loyal customers needed less and less from AMD.

Over the next year, AMD may

stage a comeback.

The company's suit against Intel will soon be decided, laying to rest the question of whether or not Intel treated AMD fairly when it terminated the technology-sharing agreement. (As of

ible processor that will survive copyright infringement challenges from Intel. And AMD is about to ship a new chip that challenges both Chips and Technologies and Harris in one shot.

The 286LX is very nearly the

AMD is rumored to be in the final stages of manufacturing a 386-compatible processor that will survive challenges from Intel.

this writing, arguments in the case were completed and the judge was in the process of writing his decision.)

This past summer, for the first time in a long while, AMD introduced its first product with mass appeal: a math coprocessor that's compatible with the instruction set in the Intel 80287. (PC Labs is now developing compatibility and performance tests for a review that will appear early next year.)

More significantly, AMD is rumored to be in the final stages of manufacturing a 386-compat-

much-fabled computer-on-a-chip. It combines a CMOS 80286 processor with all the other peripheral logic in an AT system board: the DMA controller and registers; an interrupt controller; a real-time clock with CMOS static RAM for system configuration setup; the DRAM interfaces; and even EMS management and registers.

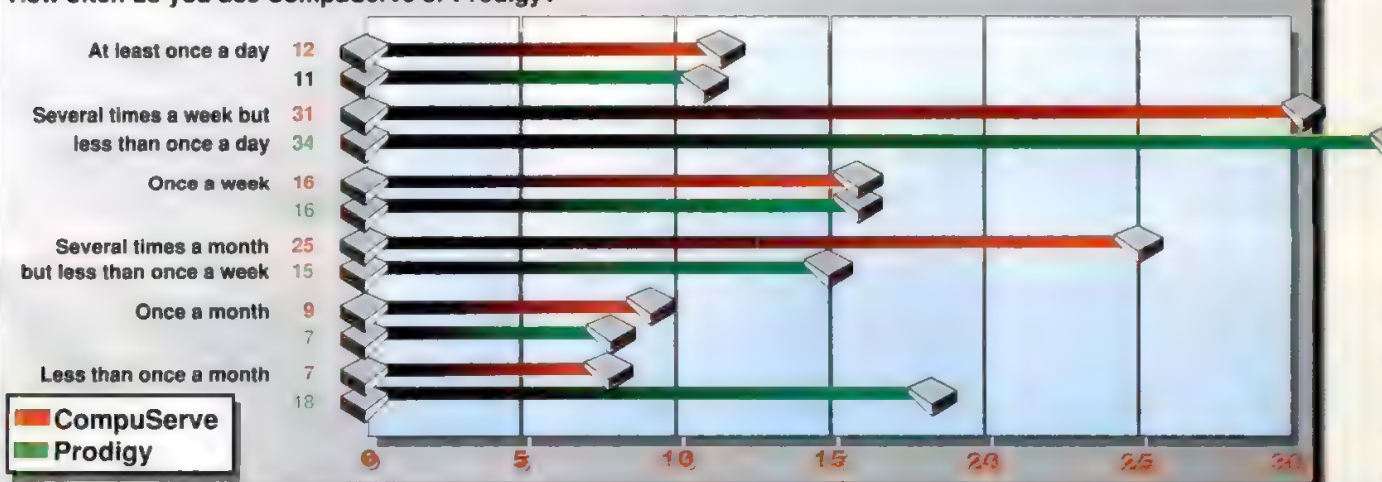
The only chips needed to complete the standard AT system board design will be BIOS EEPROMs, a keyboard controller, and RAM.

CONTINUES ON PAGE 68

MAGNET SURVEY

Prodigy has been seen as something of a test case for expanding the role of the personal computer. If it finds a market, the PC is likely to become integrated into family life, in addition to the office. We recently asked 1,057 callers to PC MagNet their opinions about on-line services and found that 15 percent were subscribers to Prodigy. Not surprisingly, this was far less than the 68 percent of MagNet callers who also use CompuServe. What was surprising to us is that the Prodigy subscribers are generally happy with the service, despite the slow response time. Sixty percent said they were satisfied (82 percent said the same thing about CompuServe).

How often do you use CompuServe or Prodigy?



Pipeline

CONTINUED FROM PAGE 67

AMD will sell two versions of the chip: one for desktops and another that's been optimized for laptops.

The laptop version will integrate several power-saving mechanisms into the chip's logic: a shut-down mode for the processor, a slower refresh cycle for RAM, and a standby mode that keeps the system clock ticking properly while the processor and RAM are hibernating.

The new designs will result in two new types of laptops. One is essentially the same as today's 286 but less costly. This type of system will likely be created by companies that are not yet in the laptop market; the AMD 286LX will pave the way for a less costly product design.

The second type of system will be a 286 laptop with more features—more ports, extra disk connectors or communications devices—thanks to the LX's ability to save space on the system board.

Slow Progress on the Road to 50 MHz

Don't expect to see a faster 486 any time soon.

Intel is behind schedule on delivery of the 50-MHz version of the 32-bit microprocessor.

It had hoped to ship the first chips late this year, but now it's saying only that it will ship sometime in 1991.

It will take system makers several months to design and manufacture PCs that use the 50-MHz 486, so it's unlikely you'll be able to buy a model until at least a year from now.

Meanwhile, Intel is still working overtime to meet the demand for 386 and 386SX chips. There's been a very strong demand for them in this country, and an even stronger demand in Europe.

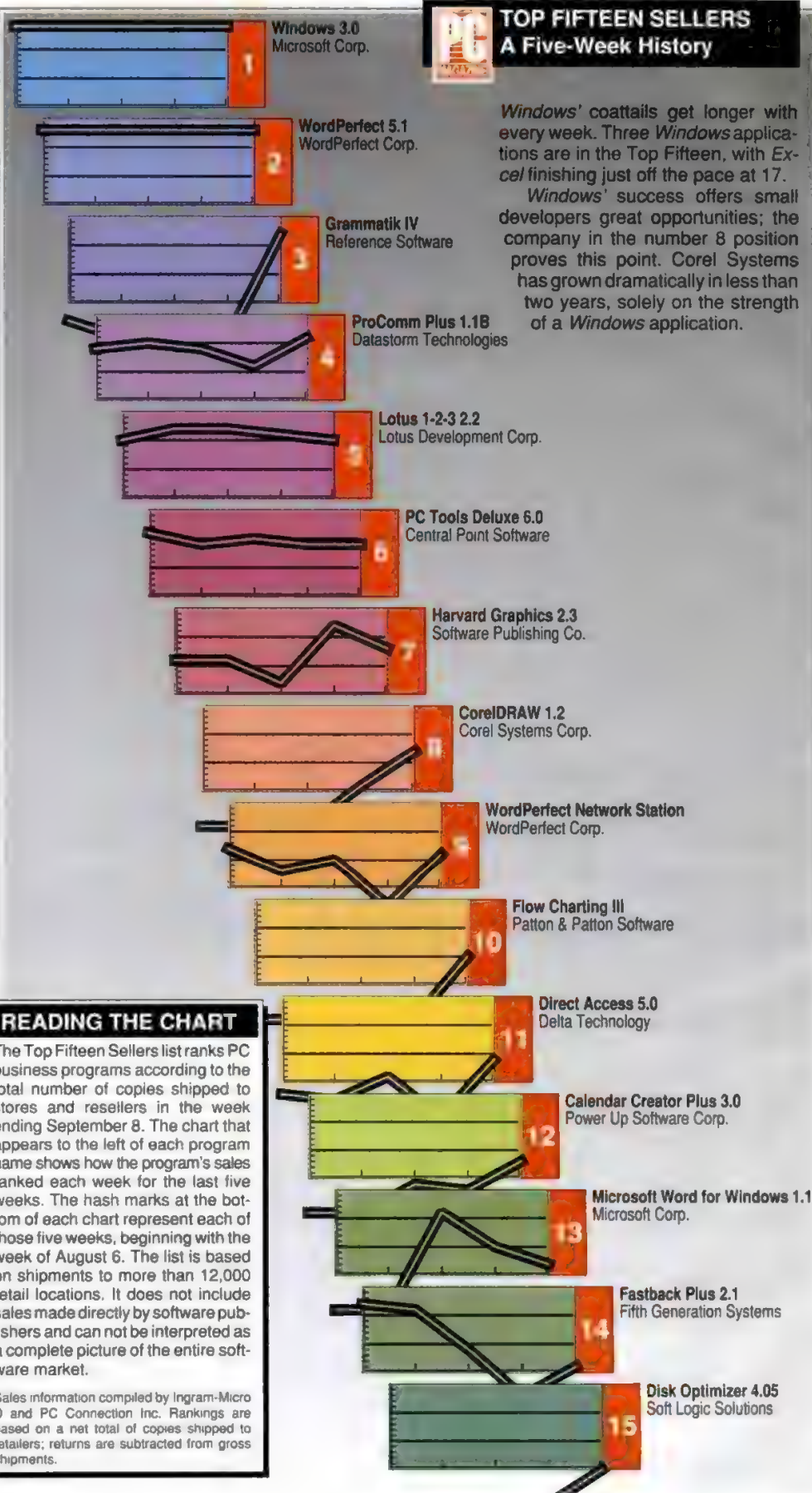
Progress Report: Multimedia PCs for Everyone

Progress in developing multimedia PCs is continuing, though not at breakneck speeds.

Everyone is anticipating a milestone in late November,

CONTINUES ON PAGE 71

TOP FIFTEEN SELLERS A Five-Week History



From The Arche Design Lab

Arche Brings Systempro™ Performance and Fault Tolerance To ISA PC Platform

3rd In a series on high performance systems by Joe Kua, Director of Research and Development, Arche Technologies, Incorporated.

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High performance systems like Arche Legacy™ workstations and Pro-File™ servers require performance subsystems. In this segment of our series, we will examine how disk subsystems in Arche 80386 and 80486, 33 MHz models are designed for read/write performance and fault tolerance.

When focusing on subsystems, it becomes fundamentally important to understand Arche design philosophy: To assure compatibility with existing standards given a strict adherence to AT and now, EISA design rules. And, in an effort to advance the state-of-the-art of PC design, our strategy emphasizes the migration of large scale systems technology to the PC platform.

Consequently, at Arche, subsystems are engineered with an eye toward large scale systems technology that works within the realm of ISA and EISA compatibility.

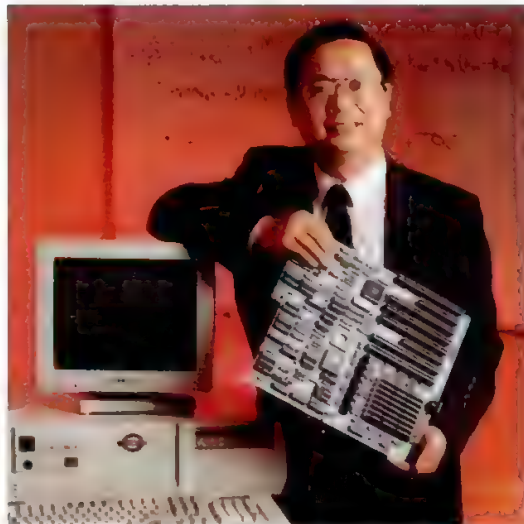
To gain an edge in ISA disk subsystem performance, Arche R&D developed Arche Breeze™, a 20 MHz ESDI hard disk controller. Arche Breeze incorporates a 32 KB look ahead disk cache, designed to work in concert with the Legacy and Pro-File's unique mainframe memory management subsystem, flagged register copy back cache, and ProCache™ intelligent controller.

By caching frequently used sectors of the disk and eliminating mechanical disk delays, Arche Breeze delivers Legacy workstations and Pro-File servers a performance advantage on every data read or write; 1/2ms for a cache hit versus 30-70ms for the disk. Also, automatic read-ahead is employed to eliminate rotational disk delays and multi-user

overwriting which occurs among controllers with simple track ahead schemes.

To minimize disk access times associated with writes, Arche Breeze automatically buffers and defers writing them to the disk until idle periods. And when writes are written, they're written in ascending order of cylinder head eliminating disk seeks, further increasing write through performance.

Arche Breeze supports any combination of 10, 15 or 20 Mbit per second ESDI drives, up to two 1.2 gigabyte units without third party software. To maximize multi-user performance, Arche Breeze will support two controllers and four ESDI drives under SCO UNIX™ and Novell.* For fault tolerant operation, Arche Breeze offers the added benefit of disk duplexing and disk mirroring under Novell.

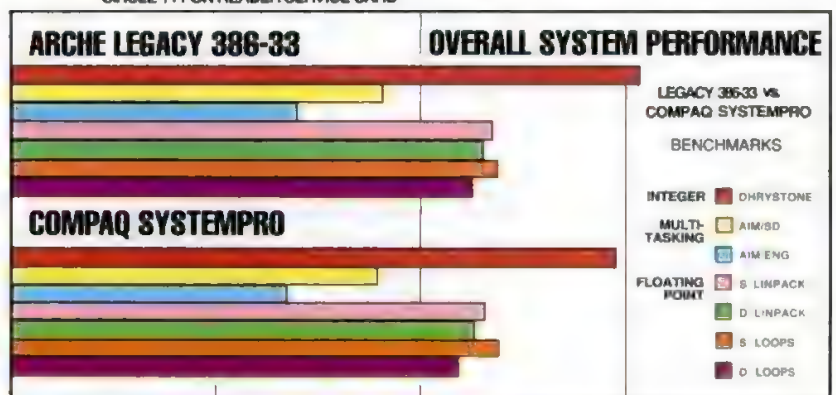


"When integrated into an Arche Legacy or Pro-File 386-33 with mainframe memory management architecture, Arche Breeze provides similar performance and fault tolerant features as the Compaq® Systempro.*"

Joe Kua

At our R&D center, and among a growing number of power users, the benefits of our design effort are now known. Arche Legacy workstations and Pro-File servers, with 16 bit ISA bus, Arche Breeze ESDI controller, and a high performance drive, "provide higher throughput than two SCSI based EISA machines, the 386-based Compaq® Systempro, and the 486-based Mylex® with 16-bit driver software," according to *Personal Workstation*, May 1990. At Arche, we consider this quality well implemented. An essential factor when your quest is to provide Quality Above All.

CIRCLE 111 ON READER SERVICE CARD



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* Base model with IMA and single 386-33 processor card.

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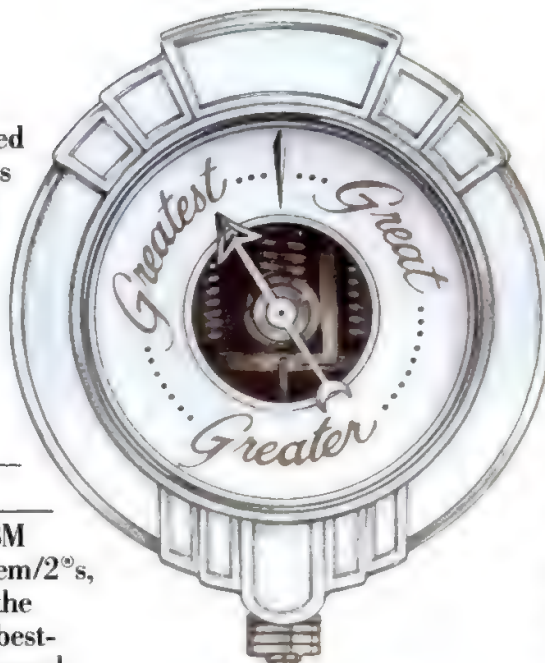
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Pipeline

CONTINUED FROM PAGE 68

when Microsoft is expected to show prototypes of an audio-video board that uses CD-XMA graphics, driven by a version of *Windows* with multimedia extensions.

That doesn't mean Microsoft wants to get into the hardware business again; it's a way of demonstrating the right standards to use in developing educational and entertaining CD-ROM-based software.

From Microsoft's point of view, the key to an inexpensive multimedia system is this nearly ready version of *Windows* that incorporates technology acquired from Macromind earlier this year (see Pipeline, May 15, 1990).

One indication of the strong interest developing in Microsoft's approach is Tandy's expected involvement.

Even though Tandy has invested heavily in developing *DeskMate* as a graphic front end, Tandy is eventually expected to sell multimedia systems that are driven by *Windows* applications.

Once the multimedia version of *Windows* is available, developers will be able to begin work on creating audiovisual applications that can be distributed solely on compact disks.

Who's Out Front with OS/2: Microsoft or IBM?

A tempest of media attention swirled around the recent negotiations between IBM and Microsoft. The two companies have been discussing the way operating systems will be developed in the future. The negotiations left lots of people confused or misinformed.

Here's a summary of where the two stand:

IBM has decided to take the lead on developing OS/2; that's a switch from the recent past. For a long time Microsoft has been leading the work on the OS/2 kernel, while IBM programmers worked on interface and communications issues.

Microsoft will now shift its focus to developing a portable version of OS/2 2.0, with the intent of producing a RISC OS/2 in the future.

With the new arrangement, IBM will press hard to get OS/2 2.0 for PCs out this year and will step up work on reducing the memory requirements.

Microsoft had disagreed in the past with IBM's priorities in developing OS/2, believing that a reduced memory requirement was not feasible without removing key features. This new arrangement is a way for IBM to turn up the heat on OS/2 development. It also puts the pressure on IBM to prove Microsoft wrong and demonstrate that OS/2 can become a viable operating system on 2MB PCs. ■

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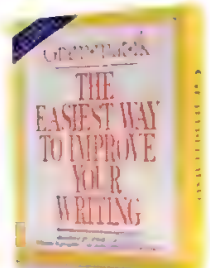
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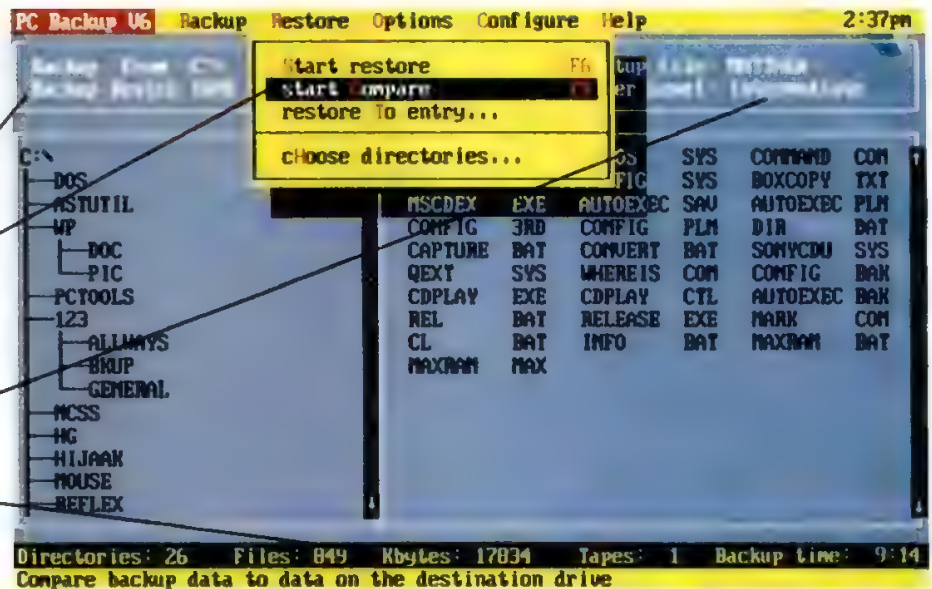
Reference Software International, 730 Townsend St., Suite 123, San Francisco, CA 94107. (415) 541-0222.
*Rated #1 by *PC World* (10/90), *InfoWorld* (9/4/89), *PC Week* (9/4/89), and is at the top of *Edgehead*, *PC Connection*, *MacConnection*, *Merisel*, *Kenhl*, and *Ingram Micro*'s best-seller lists. Grammatik is a trademark of Wang Laboratories. Other product names are trademarks of their respective holders. © 1990

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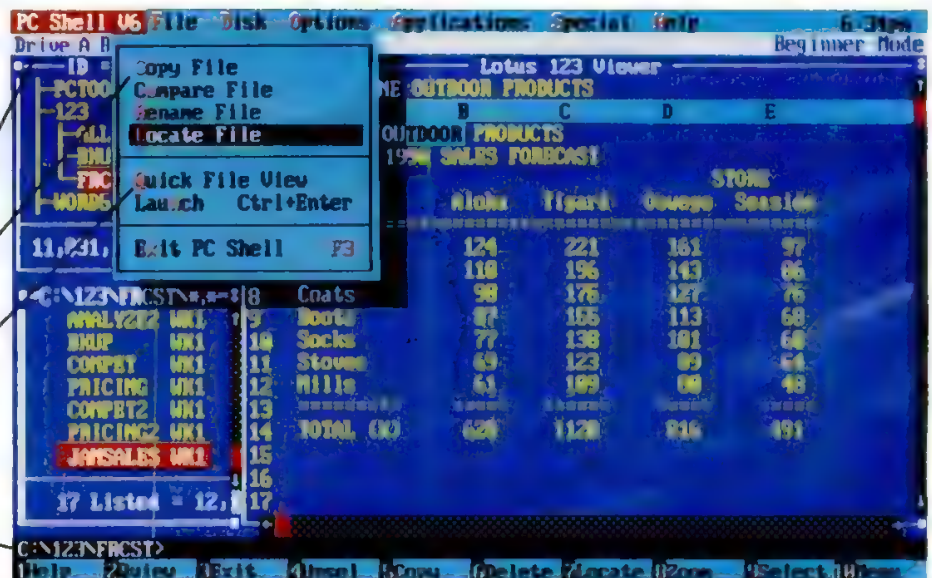


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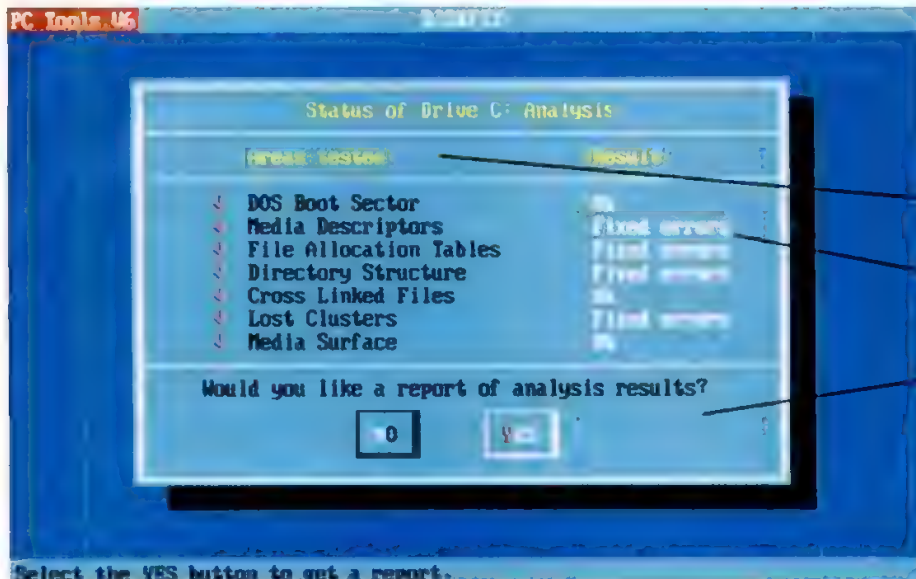


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Ed Mendelson, PC Magazine "Best of 1989 Awards," January 16, 1990



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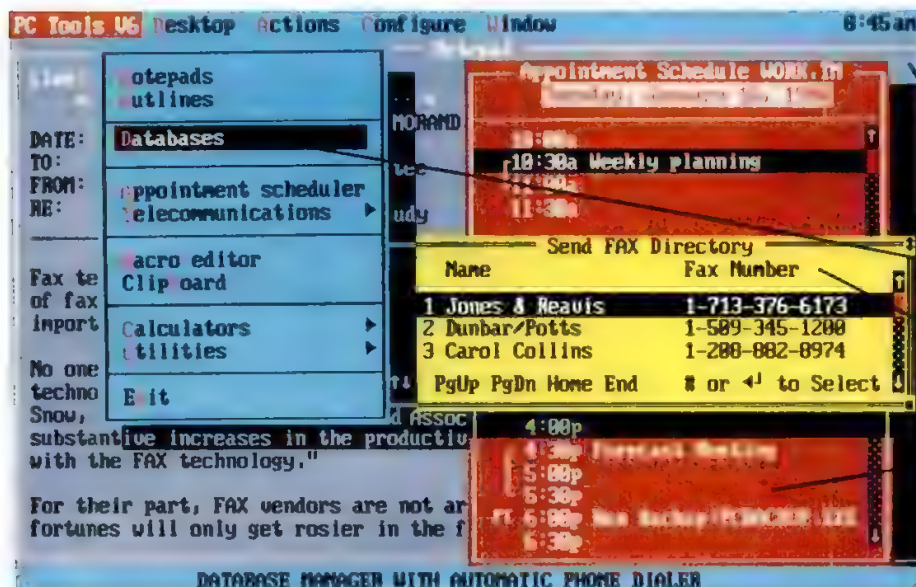
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CIRCLE 146 ON READER SERVICE CARD

Bill Machrone



The Tyranny Of Choice

Now that Windows 3.0 has really taken hold, it has the one thing we all expected least—competition.

Windows 3.0 is arguably the hottest product to ship this year. Users who scoffed at graphical user interfaces are rushing to convert their applications. Software vendors are getting whiplash injuries in their haste to reverse course as they cast OS/2 development aside and steer toward *Windows*. In Silicon Valley, about the only way you can get a *Windows* programmer is to marry one. Even though the crucial desktop publishing market is about evenly split between GEM-based *Ventura Publisher* and *Windows*-based *PageMaker*, there's little hope for competition among graphical interfaces. Now that Xerox has ported *Ventura* to *Win-*

dows, the show is over. All the interesting ancillary applications are *Windows*-based anyway.

Straight into the teeth of this competition-chilling wind

sails tiny *GeoWorks*, purveyor of graphical operating environments for Commodore and Atari machines. With its graphical environment operating system for DOS (*GEOS*), the GUI category is suddenly a two-boat race. Not that *GeoWorks* wants to race at all, preferring to go about its business without raising Microsoft's interest. Microsoft's might and marketing clout are likely to blow *GeoWorks* flat—if the giant favors it with so much as a breath.

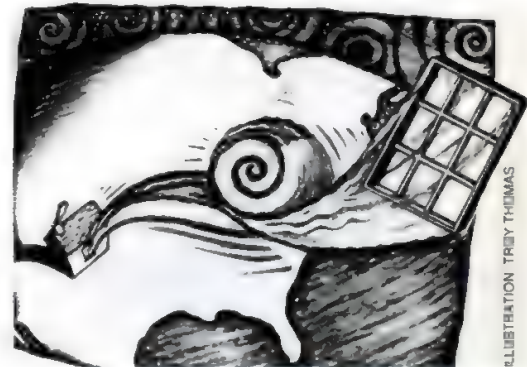
Granted, the differences between *GEOS* and *Windows* are enormous. *GEOS* makes no pretense of multitasking DOS applications (although it can launch them). Nor does it have the huge number of applications that have popped up for *Windows*. And it doesn't take a multi-megabyte machine to make it work. *GEOS* thrives in a 640K 286, and even performs respectably on an 8088. On a run-of-the-mill 386, *GEOS* performs crisply in a way that *Windows* only dreams of. It also looks better. *GEOS*'s default interface is OSF's *Motif*, and I find it much more handsome than *Win 3*. It's also a chameleon, giving you the choice of a *Windows 2* look, if you so desire.

Now why would Microsoft care about an upstart company that has publicly stated that it doesn't want to compete? Because it makes Microsoft look bad. Through all the years of

effort on *Windows*, all we've heard is how difficult it is to build a windowing environment for the PC. Also, Microsoft swore up and down to the corporate community that *Win 3* would run well on the 286 machines' 1MB installed base. Well, it runs, but that's about all you can say for it. *Windows* doesn't really come to life until it's on a 386, and therein lies the huge market opportunity for *GEOS*. There's a huge installed base of machines out there that no one will upgrade or trade in any time soon.

IF IT WERE EASY...

The key to *GEOS*'s performance and small size is that it's written in assembly language. The upshot is that it's several times smaller than *Windows*. Its applications are also a fraction of the size of equivalent applications in *Windows*. Sold for \$195 retail as *GeoWorks Ensemble*, it includes a word processor, paint program, two telecommunications packages, and a personal information manager. It saves space because the *GEOS* kernel provides a sophisticated array of services to each application, freeing the programmer from many space- and time-consuming tasks. The kernel itself is only 55K, including a PostScript-like font



manager that provides a consistent font display and printing model for the screen and output devices. This, you'll recall, is the hot issue that is still being debated in OS/2 circles. It's not an issue for *Ensemble* applications. If you want to print 24-point Cooper Black at a 15-degree angle, it'll look the same on your screen as it does on your printer. What's more, the font manager is available to every application that wants to use it.

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Bill Machrone

GEOS also gets a boost from being object-oriented internally. Designing a graphical operating system around objects and classes not only keeps things lean and mean, but gives applications programmers a rich collection of services to draw upon, which keeps the applications small. *Win 3* definitely looks bad by comparison.

Now comes the geo-politics, if you will. IBM and GeoWorks were working on a concept last year called *PM Lite*. The idea was to largely duplicate the Presentation Manager user interface and application program interface, but over DOS, not OS/2. The intention was to offer what Microsoft had been unable to deliver: a smooth transition from DOS to OS/2 for graphical programs. Microsoft severely strained its relationship with IBM in the ensuing struggle to have *PM Lite* shelved because of the threat to the huge investment in *Windows*. GeoWorks, however, continued development. Now there's a choice in graphical operating environments, and some large players, including Lotus, have indicated that they're interested in developing software for GEOS.

And what if GEOS is a success? Is IBM preempted from offering it? Not completely. The PS/1 contains a runtime version of GEOS with a custom interface that gets you into your major applications and the Promenade on-line support network. GEOS's graphical implementation is the most sophisticated, user-friendly communications program yet offered for DOS, because the user and host machines work together cooperatively to offer intelligent menu choices and terrific ease of use.

Meanwhile, a number of retail-oriented manufacturers are bundling *GeoWorks Ensemble* with their machines. It's ironic that the PC buyers who shop for computers at K mart will go home with a superior user interface, rich scalable fonts, and all the other Maclike things we've been waiting for so long. With a little luck, they may never see the C:\> prompt.

Almost everything good in this industry has come from the bottom up, not the top down. GEOS is certainly a bottom-up approach to the market, but with serious implications for those in the middle and the top. As a user and a brand specifier, you owe it to yourself to understand GEOS and the choices it offers.

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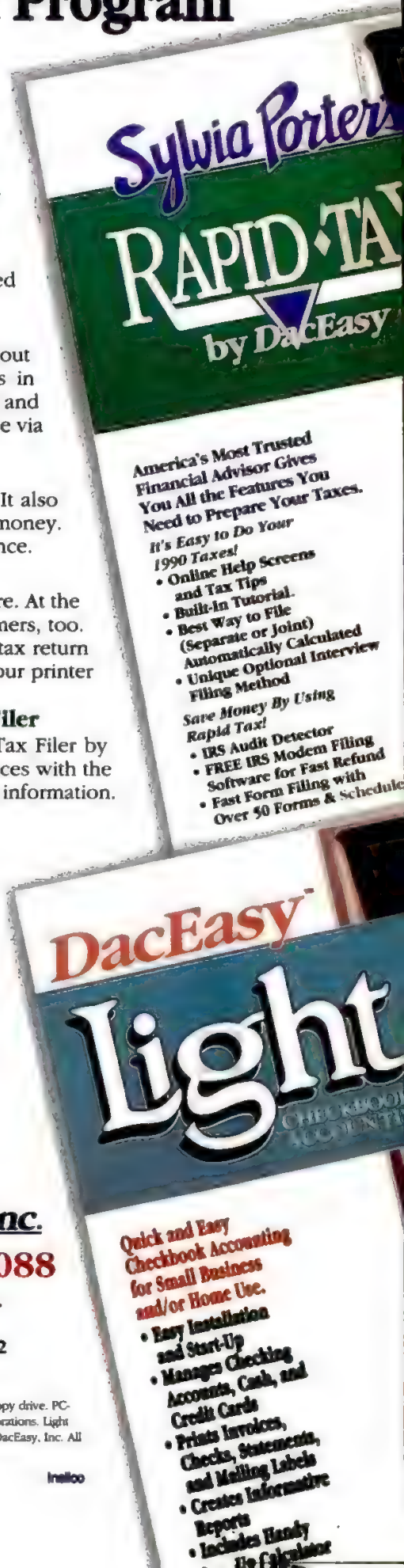
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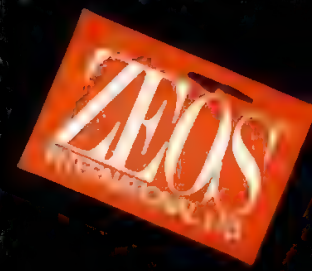
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John C. Dvorak



The Death Of Code

Copyrighting code could signify the end of innovation within our industry.

A few hundred protesters surrounded the corporate headquarters of Lotus Development Corp. recently to express a disgust with Lotus. The company has taken legal actions to protect its user interface rights. The group protesting calls itself the League for Programming Freedom. Led by famed programmer Richard Stallman, the group says that the precedents created in the Lotus versus Paperback Software case and now the Lotus action against Borland will stifle progress and in the long-term, hurt the industry. They're right.

The league has publicly attacked both the copyright laws and the patent laws as they apply to software. In fact, the concept of copyrighting the look-and-feel of software is a disastrous idea. The programmers want the underlying code protected, but that's all. The

best analogy is the one that is what copyrights are all about: books. In books, the user interface is the same. Open the cover, start flipping through pages. All that is protected is the exact wording. Even the stories aren't protected. Can you imagine the paucity of literature if the "boy meets girl" story could only be written once? Even the titles of books cannot be protected by copyright. Only the exact words—the code itself—is copyrightable.

To make the book metaphor correspond to software, we find four similarities that should be obvious to the courts: the user interface, the package, the code, and the function.

The interface in the book comprises three aspects: the typeface, the book model (hard cover, paperback, folio, etc.), and the language presented to the reader (French, English, German, whatever). None of this is protected; it would be ludicrous. Why should it suddenly be protected in a different environment?

The package is the size and dimensions, cover jacket, stuff like that. Obviously this cannot be protected either.

Then there is the code itself. It can be in any language, just like software. It can be protected by copyright, just like software. Plagiarism is the sin here, not reverse engineering. Remember a few years ago when a slew of movies such

as *Big* appeared with the same theme of a boy and an adult changing places in life through magic? They all had the same look and feel, didn't they? It's idiotic to think that any one of them should be protected on this basis. That's what we have with Lotus. The scripts were all different. Just as different as Paperback Software's code was different from Lotus's.

Finally, there is the function. In books, the function can be to amuse, inform, anger, or whatever. In nonfiction, the books can do a variety of helpful things, just like a spreadsheet program can do a variety of helpful things.

Among all these aspects of the book model *only* the exact words are copyrighted. And we're not talking about trivial words or phrases such as "he said." Lotus wants us to believe that something like "retrieve file" or the back slash is protected. Nonsense. It's no different from trying to protect "he said" in a novel.

Even more incredible is the sudden emergence on the scene of a patent to protect computer code. Why can't I patent a cute one-liner in my writing? The patent system was designed to protect small-time inventors from exploitation, not to protect methodology. A software program is all methodology. It's a



series of instructions given to a piece of silicon to tell it what to do. It's nothing more than a list of instructions.

Before it's too late, it's time Congress takes this problem seriously and restructures both the patent and copyright laws. Contact the League for Programming Freedom, 1 Kendall Sq. #143, P.O. Box 9171, Cambridge, MA 02139, to find out more ways you can help keep innovation alive.

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who should know something about developing applications, named it the best applications software. And Government Computer News cited reliability, compatibility and speed as some of the reasons they awarded Professional ORACLE Tools and Database the number one data manager for local area networks.

ORACLE for Macintosh received its share of acclaim from Info World readers, who named it Macintosh Product of the Year.

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Inside Track

The plot thickens as AMD wins big in a lawsuit with Intel. The possibility that the **386 may be legally cloned** is becoming a

reality. So much so that Intel is already taking a defensive posture by putting together advertising campaigns that emphasize that Intel invented the chip.

A federal judge made an interesting ruling concerning the AMD 80C287 chip that may affect the entire Intel line. This chip is highlighted in a **copyright infringement** suit initiated by Intel. U.S. District Judge William Ingram said AMD may not: 1) Use Intel's copyright notices; 2) Claim that the chip is an Intel equivalent or is **100 percent-compatible** with the 80287; 3) Claim that AMD is an authorized licensee. BUT it could **legally manufacture** and sell the chip!

Apparently, because of signed agreements and as a result of this ruling AMD can use certain Intel microcode. This whole case is part of a big lead-in for the AMD 386 clone. The **fireworks** have just begun.

Street Price Phenomenon Dept.: At a recent *PC Magazine* Editors' Day, I realized that a new phenomenon in the PC market world exists. I call it the SPA—**Street Price Apology**. Whenever you criticize a company for its prices, they all say, "Yeah, we know the price is high, but the street price is...." It's as though the entire industry has become gray market oriented. Companies have to offer **huge discounts** so the "street price" can be much lower than list price. Supposedly this encourages sales because **customers are dumb**, and think this is a bargain. If a company wants to sell a product at a firm price, they're doomed. The entire retail side of the business is going down the tubes.

So here's a **great new graphics card** with a street price of about \$640 and a list price of \$1,024. Appropriate numbers, if you think about it. It also means the re-emergence of **Hercules** as a player in the display card business. It's called the Hercules Graphics Station Card. VGA compatible, this card can, with its one megabyte of video memory and with the aid of the TI 34010 chip, produce **nine different** resolutions including a 512 by 480 by 16.7-million true colors on a standard VGA monitor. If your MultiSync can tune to 48 kHz, you can get a beautiful 256-color 1,024-by-768 noninterlaced super-sharp display, too. This card is simply **stunning and incredibly fast!** Call Hercules in Berkeley, California, at (415) 540-6000 for more information. Highly recommended.

The Real Thing Dept.: If you've been considering making your HP LaserJet a PostScript-compatible machine, there haven't been too many satisfying options. There is the Pacific

Data cartridge, internal upgrades, and even some emulation software. I have **been reluctant** to recommend any of

these solutions as they are either too slow, too expensive, or **too awkward**. Finally, the company that invented PostScript, Adobe Systems, has released a series of cartridges for the LaserJet line. I can easily recommend these products. They're fast and obviously 100-percent compatible. The basic cartridge is \$495 and contains the standard 35 outline fonts found on most PostScript printers plus the PostScript language needed to decode PostScript files. This is a **superb product**. Contact Adobe at 1585 Charleston Rd., Mountain View, CA 94039; (415) 961-4400.

Genuinely Interesting Software Dept.: If you need a gag for that speech you have to give to the Rotary Club next week, consider the **Humor Processor**. It's available from Alan Macy Software for \$49.95. Call Alan at (415) 843-1034 for a copy. Most of these joke programs I've looked at are **pure junk**. But this thing actually helps you write some pretty good jokes. It's almost **amazing**. "So these guys showed me a laptop computer which was such an 'old fogies' machine that the only thing missing in the design was a bald spot." Hey, it was my first try!

Inside Track Looks Back Dept.: I got an interesting letter from a reader at Boeing (I guess he should remain nameless) to update me on the **status of Boeing Corp.'s shoddy lobby**, which I discussed over four years ago when the company attempted to enter the software business

with a surprisingly good spreadsheet called *BoeingCalc*.

"Your name came up the other day at Boeing Computer Services where I work. Somebody remembered an old column of yours making fun of the lousy conditions we have to work under. As it turned out, several of us remembered that column, and we broke up in laughter because nothing really changed since then. Oh well, maybe there are more partition walls and less of that warehouse look, but the cubicles are so small and noisy from phones ringing all over that concentration is just as impossible as before. Things started improving during the short reign of Mike Hallman, but after we lost him to Microsoft, his replacement is another old Boeing hand, so who knows what's to come now?"

I only run this letter because I never got so much **hate mail** as I did the first time I talked about Boeing. Maybe the cheap environment is an important part of the culture. Kind of like the way **Newark, New Jersey**, has a certain magic. (And smell.) Just kidding! No letters, please!

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Clear the stage. We've all seen plenty of 386SX systems, and most of them have talent. But there's only one 386SX that can dance through IBM software routines without upstaging your budget. That's the Premier 1500. And, like a real star, this one has something the others don't—a free 14" Premier VGA monitor!

Get a load of this resume: 40-megabyte hard disk drive, 1-megabyte main memory on board, easily expandable to 8 megs on board. VGA video board. Single floppy, 1.2 megs. Five expansion slots. And she's fully compatible with IBM.

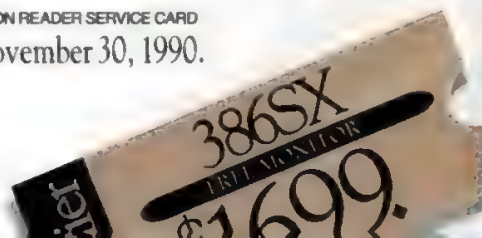
And what a background! The Premier 1500 uses the Western Digital hard drive, the blue-blood of the industry. Plus, there's a full year of on-site service by TRW.

Normally you'd pay \$2699 for this package. At \$1699, you can't miss. But hurry... this kid's going places.

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INNOVATIONS



Jim Seymour



The Notebook-PC Market Roars to Life

Sharp not only made a great notebook PC, it's doing wonders for the whole market.

As much as computer journalists (ahem . . .) love to label a dozen new wonders every year as landmark machines, destined to change the course of history, a backward look reveals few PCs that have really changed how we work with computers.

But a new machine—actually, three versions of one new machine—has just come to market. These three machines seem to me to truly qualify as landmark PCs, destined for important roles and market success. And part of that distinction is going to come from how they're being sold.

The notebook-PC area is about to become one of the two hottest corners of the PC market. Desktop 386SXs are already so hot, with such frantic price competition (and such great buys for PC users), that nothing could edge them out of the headlines. But notebook PCs are going to come close.

And the machine that defines the notebook PC in our minds, I'm convinced, is going to be the Sharp PC-6220, along with its

twins, Texas Instruments' TravelMate 2000 and CompuAdd's Companion.

THE RIGHT STUFF

Sharp showed prototypes of the machine quietly last winter and spring; deliveries started in early summer. I've been using one or another of these machines for several months now, and I continue to be amazed at just how *right* it is.

Sharp's designers put in almost everything notebook PC users really need. There's a superb VGA display: big (6 by 8 inches), bright, backlit. The keyboard is exceptional: key travel isn't quite as far as on keyboards meant for desktop PCs, but this is the best portable-PC keyboard I've ever had, one that I have liked since the first time I used it.

Inside the box there's a 12-MHz 286 chip, one megabyte of RAM, and a tiny, fast PrairieTek 2.5-inch 20MB hard disk. You can add in a 2,400-bit-per-second fax/data modem or a

card to drive an external color VGA monitor; RAM is expandable to 3 megs. There are built-in parallel and serial ports, and DOS and LapLink are in ROM.

The PC-6220 runs for 2 hours on a tiny, user-changeable internal battery; you can also clip an extra battery "slice" onto the back of the machine for a total of 5 hours of power. The external AC power supply is light and compact, and finally achieves that magic 1:1 ratio of battery life to recharge-cycle time: the true 2-hour-capacity internal battery recharges in just 2 hours.

Best of all, the machine weighs four and a half pounds, measures 8.5 by 11 inches and is just an inch and a quarter thick. Wow.

Yeah.

Sounds too good to be true? The first time I heard the specs, I thought that, too. The first time I *used* one of the machines, I looked for the famous "VAX behind the curtain" trick: the company couldn't have really gotten all that into this little box.

But to use the PC-6220 is to love it. It's the first really useful notebook computer, and it's going to define the class for some time to come.

There have been other stabs at the "right"



ILLUSTRATION: TROY THOMAS

notebook PC, but all of them were missing something. For example, NEC's pioneering UltraLite, which I carried and used for over a year, asks too much with its silicon hard disk: obsessive battery charging or you lose everything. And NEC never delivered on the promise of the machine's ROM-card approach to software. Compaq's LTEs (via the Citizen Watch Co. in Japan) are clumsy, with poor construction and a weird keyboard layout.

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Jim Seymour

But Sharp got things right.

I said a part of the machine's success—a big part—and thus a contributor to its landmark status, is that the same machine will be available concurrently from other vendors as well. Texas Instruments will sell you the machine, and CompuAdd has it, too.

There are a few differences among the three. The TI and CompuAdd versions have a ribbed panel on the exterior, which I find a great help in carrying this no-handle-needed machine without dropping it; Sharp's version is smooth. The Sharp has an ugly two-color keyboard, while the others are a more attractive matte gray. All of them have too much distracting white silk-screening near the display for my taste. All have power-conservation circuitry, though TI (which manufactures all three machines in Temple, Texas) includes additional battery-conservation tricks and a nifty, customized version of *Battery Watch* in ROM.

Sharp and Texas Instruments price their versions at \$3,995; CompuAdd sells it directly for \$2,895. I suspect most Sharp and TI dealers will be discounting their units down to about the CompuAdd level.

THREE OF A KIND

Though certainly we've seen lookalike machines available from several vendors before—remember all those awful knock-offs of Compaq's lunchbox portables?—this is the first time we've seen unabashed name-brand duplicates available from several sources at the same time. By in effect OEM-ing its design through Texas Instruments to competitors, Sharp has chosen a difficult and dangerous path for itself—but a path which is likely to make the machine the first real standard in the notebook-PC business.

I doubt that this approach is going to become the norm in PC hardware distribution—least of all with the confusing and overlapping channels in this mix—but I also greatly admire Sharp's initiative. By following the notion that it's better to have one slice of a big pie than all of a tiny pie, Sharp is providing a kind of market leadership that hasn't been very visible in the PC business lately.

And in the process, Sharp and its distribution partners have made one hell of a PC for you and me.

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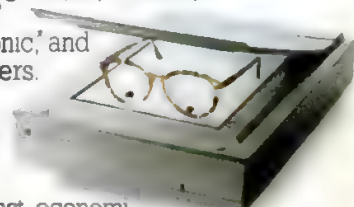
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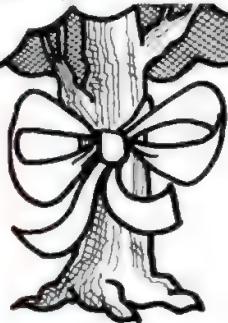
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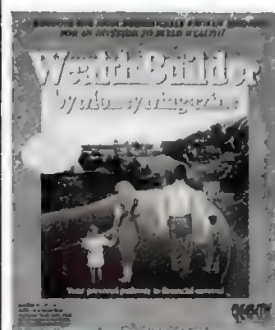
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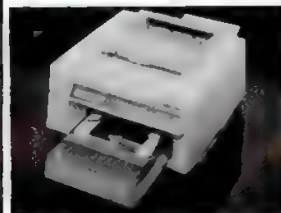
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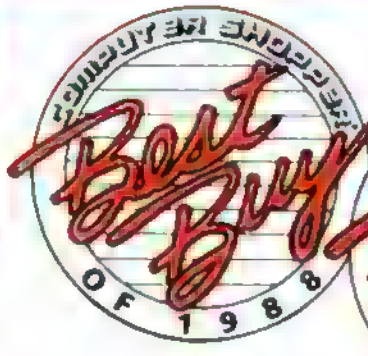
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William F. Zachmann



Windows 3.0 has had extraordinary success. The rollout of OS/2 2.0 will likely be equally successful. This will probably cause the mainstream migration path for the majority of IBM and compatible systems running DOS to be via *Windows* to OS/2. Nothing, however, is certain about the future. Other outcomes are always possible. That's what makes not only the computer industry but life in general such an interesting undertaking.

The major alternative to the DOS-*Windows*-OS/2 migration path has been Unix, in one form or another. But in the past Unix lacked a clear scenario for how it could win the battle for the office desktop.

Unix first appeared as a serious graphical contender for office desktops in the commercially viable GUI found on Sun workstations. Building on

its success in the specialized, high-end market for scientific/technical/engineering workstations, Sun has moved aggressively to sell lower-cost systems into the broader office market. Sun's RISC-based SPARC systems have made the company a serious player in office systems.

However, despite sales approaching one Sun SPARC system for every four Apple Macintoshes sold, a growing software base, and inroads in key market segments (among New York financial services firms, for example), Sun's market share remains far below that of the mainstream DOS-*Windows*-OS/2 axis.

Recently, a big player in Unix has been the Santa Cruz Operation with Xenix and now Unix. SCO has become a key competitor by creating Unix for the same Intel architecture systems that also run DOS and OS/2, as well as by taking the lead in providing a multiprocessor operating system for the new class of servers like the Compaq Systempro.

While SCO provides support for graphical desktop software via the *OSF/Motif* interface, SCO Unix remains a tool primarily for those who want to build traditional multiterminal character-mode Unix systems using Intel-architecture personal computers. It has not really

been a big factor, so far, in supporting GUI-based desktop applications.

The entry that may prove to be Unix's best shot at capturing office desktops is, paradoxically, not really based on Unix at all! It is the fundamentally DOS-based *DESQview/X* from Quarterdeck Office Systems.

DESQview/X is an extraordinarily ingenious combination of elements. Based on Quarterdeck's popular DOS product *DESQview*, *DESQview/X* makes use of the Unix-based X Window protocol to create a bridge between DOS and Unix. In the process, it may provide an important way for the Unix camel to get its nose under the tent of a lot of DOS systems.

Ordinarily, a PC program communicates with the display, keyboard, and mouse by directly manipulating the hardware ports (for example, DOS software), through a defined set of the operating environment (*Windows*), or through operating system calls (OS/2). These calls constitute the graphics applications program interface (API) and are compiled directly into the program.

With X Window, however, the application communicates with the display by means of a standard set of external message protocols that



ILLUSTRATION: TREV THOMAS

define communications between the X Window client and the X Window server across several different hardware architectures, operating systems, or environments.

X Window is, in effect, a standard protocol by which a program (the X Window client) instructs software on a system with a graphical display (the X Window server) to put things up on the screen. It defines a basic interface protocol between a program and a display engine

The Other "Windows"

DESQview/X running the X Window protocol might give Unix a place on the business desktop.

William F. Zachmann

through which a user communicates with the program.

Moreover, a given X Window server may be in communication with multiple X Window clients. That is, more than one program, possibly running on more than one system, can be displayed simultane-

ously on a single X Window server.

(Note, by the way, that the X Window terminology uses the words *client* and *server* in a manner that reverses the way these words are more commonly used in personal computer networking, making the server the smaller entity. In the X Window model, the client is a program that outputs to one or more windows on the display of the desktop system, the X Window server.)

X Window itself is a fairly basic protocol. The competing user interfaces from OSF (*OSF/Motif*) and Unix International (*Open Look*) are both based on it. Additional software, typically an X Window manager, and X Window toolkits go beyond the interface's basic capabilities to provide additional features such as user control over the display and the specific look and feel of applications.

THE FUTURE OF UNIX?

DESQview/X provides its own window manager and toolkit while also supporting the Unix-derived, X Window-based GUIs. *DESQview/X* also provides facilities to permit well-behaved character-mode DOS applications to run as X Window applications. As a result, a personal computer with *DESQview/X* can multi-task older DOS applications and X Window applications at the same time.

In addition, however, *DESQview/X* makes it possible not only to run DOS applications running on remote systems as local X Window applications, but to run DOS applications on Unix workstations with X Window capabilities as well.

The negative side is that *DESQview/X*, like *DESQview*, has considerable limitations running ill-behaved DOS applications and even greater limitations in running DOS graphical applications.

Those who really want to run *Windows* 3.0 or OS/2 Presentation Manager applications are unlikely to find *DESQview* or *DESQview/X* an attractive alternative.

Where, however, there is already some commitment to the use of Unix on larger systems and/or investment in X Window-capable workstations, then *DESQview/X* may be a very attractive alternative indeed. It offers more flexible and powerful DOS/Unix bridges than do most of the basic DOS-under-Unix alternatives.

Since Unix is virtually certain to be a factor in replacing proprietary operating systems on larger multiuser systems, *DESQview/X* may prove to be a popular alternative for linking them with DOS-based desktop systems.

My own view remains that *Windows* and OS/2, rather than Unix, will inherit the world of the DOS desktop. Nevertheless, *DESQview/X* is an interesting new entry that just might boost Unix's chances there. Like Sun's excellent workstations and SCO's Unix for Intel-architecture PCs and servers, *DESQview/X* appears to be one of Unix's brightest hopes for a future on office desktops. ■

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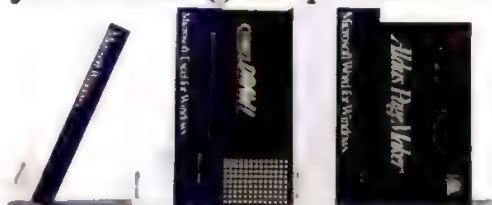
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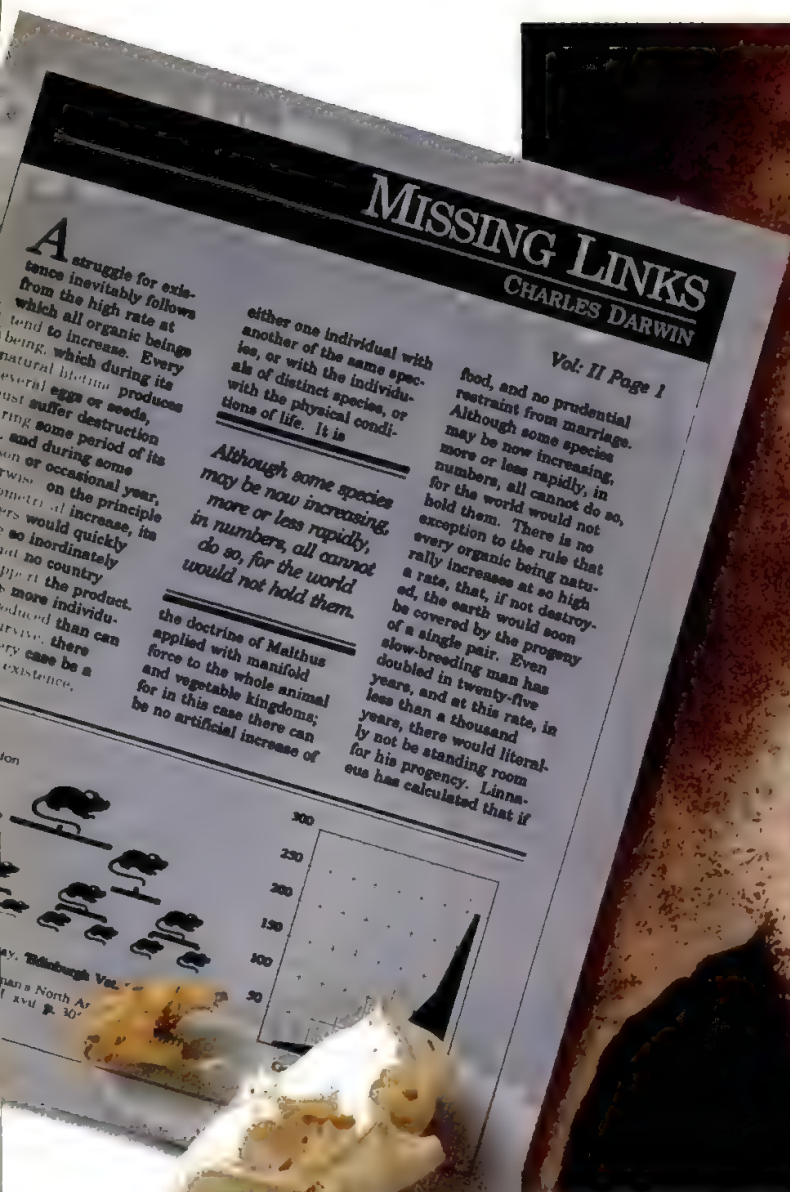
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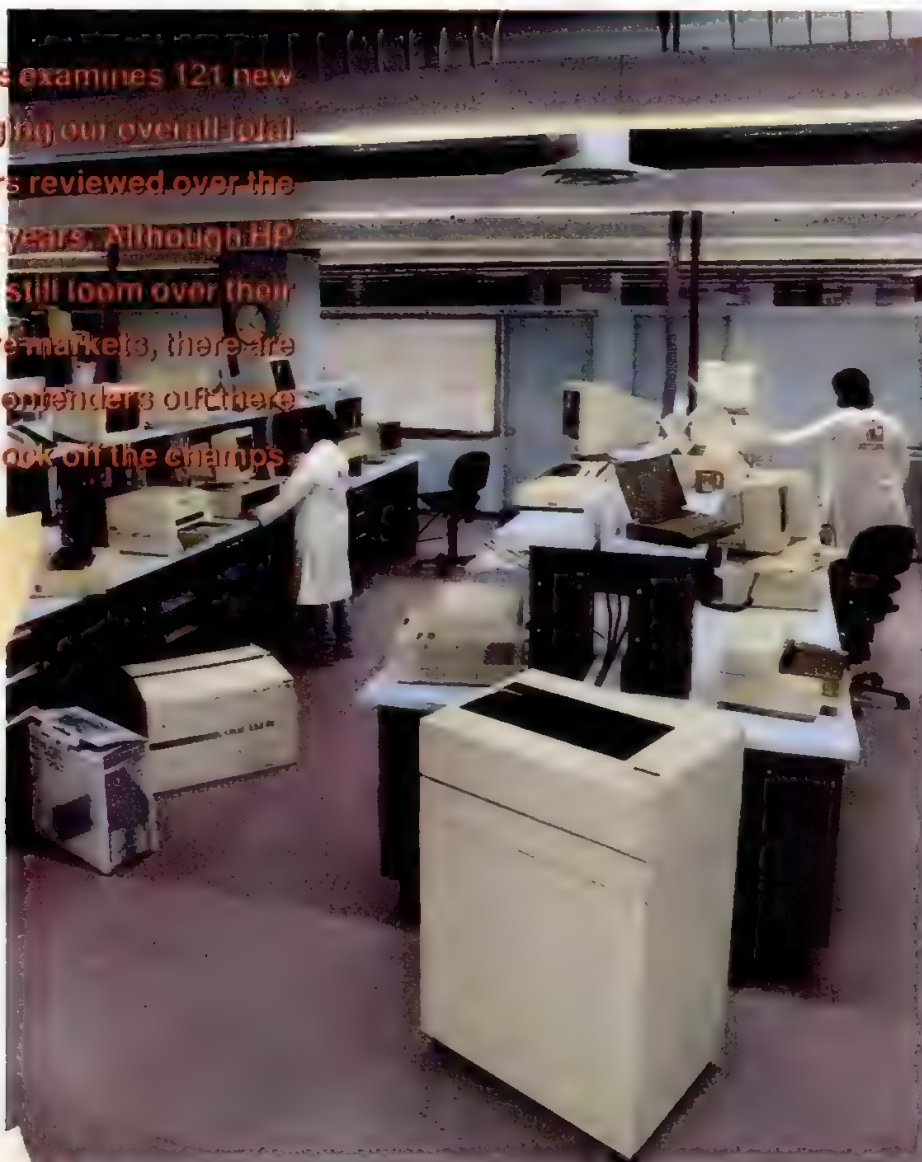
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PC Labs examines 121 new printers, bringing our overall total to 713 printers reviewed over the last seven years. Although HP and Epson still loom over their respective markets, there are plenty of contenders out there looking to knock off the champs.



PRINTERS

BY BILL HOWARD

You can approach *PC Magazine's* seventh annual printer issue in two frames of mind:

- "You're crazy to buy anything but an HP LaserJet."
- "121 printers! This has got to be some kind of horse race."

We admire both schools of thought, and there's something to be said for each. In the mainstream laser printer market, Hewlett-Packard *does* have a stranglehold in all areas: sales leadership, technology leadership, price leadership. At the same time, there's never been a greater variety of laser printers available. Among dot matrix printers, however, which outsell laser printers in unit

7th
ANNUAL
PRINTER
ISSUE

volume by 3 to 1, the playing field is a bit more even.

This is the seventh edition of our annual printer issue. It's also the biggest, thanks to the vibrancy of the printer marketplace. Two years ago, a \$1,000 laser printer was a dream; now you've got your choice of nearly a dozen. Modularity and expandability are in: More and more laser printers let you start out with HP compatibility and upgrade to PostScript capabilities for a shade over \$500; IBM even lets you retrofit a faster engine.

We're seeing higher-speed laser printers (12 to 20 pages per minute) gain popularity in shared environments where it's possible to drive a garden-variety 8-ppm laser into the grave in 12 to 18 months. B-size (11- by 17-inch) printers have emerged for number crunchers and graphical users. Ditto for affordable color printers and high-quality color printers for presenters and designers. And third parties are offering intelligent, nearly idiot-proof ways to hook up printers to local area networks.

Some of the best news is just over the horizon. Printer-engine speeds may double over the next year with little increase in price. By year's end, you'll see something called "multifunction peripherals," combining a laser printer, scanner, fax machine, and photocopier. And you'll see color laser printers such as the Canon CLC-500. So while 121 printers may be a record to date for a *PC Magazine* printer issue, there's much more yet to come.

PRINTER TRENDS

Here's the lowdown on what's happening in the printer market this year:

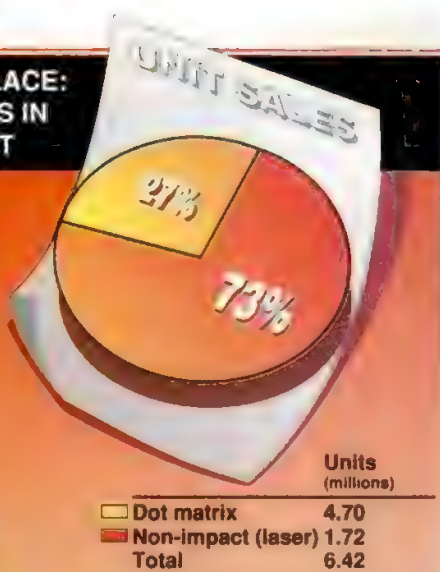
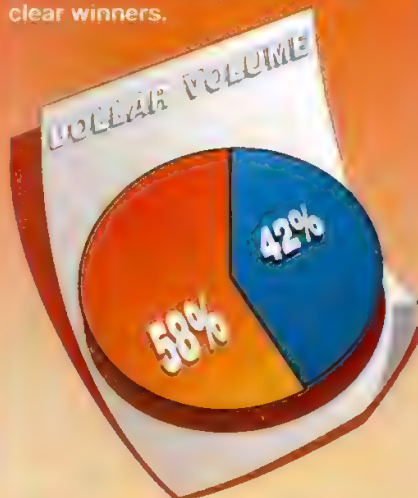
Affordability. You can find a decent 9-pin dot matrix printer for less than \$200, a 24-pin near-letter-quality printer for less than \$300. Personal laser printers sell for less than \$1,000 on the street; HP's breakthrough HP LaserJet III sells for less than \$1,750; and you can also find PostScript laser printers for less than \$1,750. You can expect further economies in laser printer prices in the next year, but the low end of the dot matrix market hasn't got much of anywhere to go. John Warnock, CEO and chairman of the board of Adobe Systems, predicts that a PostScript-based laser printer will sell for less than \$1,000 by the end of next year.

Lasers gain market share. Because they're so cheap, lasers now account for 30 percent of PC printer sales and 60 percent of the dollar volume, according to



THE PRINTER MARKETPLACE: THE TOP TEN COMPANIES IN IMPACT AND NON-IMPACT

When it comes to units, dot matrix printers continue to outsell lasers. But when it comes to dollars, lasers have taken the lead. Hewlett-Packard and Epson are the clear winners.



Dollars (billions)	
Dot matrix	\$2.6
Non-impact (laser)	\$3.6
Total	\$6.2

SALES LEADERS

Dot matrix printers account for three-quarters of sales in the U.S., but laser and other non-impact printers (for instance, LED or LCD machines) have the bulk of the dollar volume.

- Non-Impact (Lasers)**
1. Hewlett-Packard
 2. Apple
 3. Panasonic
 4. NEC
 5. DEC
 6. Brother
 7. Kyocera
 8. Canon
 9. QMS
 10. GCC

Source: BIS CAP International. 1989 sales of dot matrix printers less than \$1,000 and non-impact printers (lasers and similar products) less than 12 pages per minute.

- Dot Matrix**
1. Epson
 2. Panasonic
 3. Okidata
 4. Apple
 5. Star Micronics
 6. IBM
 7. Seikosha
 8. Citizen
 9. NEC
 10. Brother

Epson and HP are clear sales leaders among dot matrix and laser printer vendors, respectively. By some estimates, HP sells four of every ten laser printers.

BIS CAP International, a Norwood, Massachusetts high-tech research and consulting firm. Lasers don't have to cost the same to compete with dot matrix. As a rule of thumb, at the \$1,000 price point, would-be buyers consider products within a \$300 range to be comparable, so a rugged \$650 24-pin dot matrix printer, a whisper-quiet \$750 ink jet printer, and a sexy \$900 personal laser printer can factor into the same buying decision.

Dot matrix's long-term cost advan-

tage. Lasers may be sexy and the output looks great, but when the bottom line is the bottom line, dot matrix printers often come out ahead. Every time you crank a page through a laser printer, you consume 2.5 to 3 cents of toner and drum life, plus a penny for the sheet of paper. If you run through one 250-sheet paper tray daily, in 13 months you will have spent more for consumables than you did for your \$2,000 laser printer. Dot matrix output costs less than a penny a page.

Scalable fonts, true WYSIWIG. You'll see increasing numbers of laser printers sold with the ability to instantly create characters in any size you want, rather than a handful of fixed sizes. That's what makes the HP LaserJet III so popular. A software product, *Adobe Type Manager (ATM)*, will soon give you that capability on virtually any printer (dot matrix included) for \$99. So should the next version of *Microsoft Windows* with something called TrueImage. And you'll be able to retrofit scalable font abilities, typically Adobe PostScript, to many laser printers for as little as \$500; less if you opt for PostScript or PostScript emulators running in software.

The HP juggernaut. No mistake, Hewlett-Packard is the laser-printer pacesetter for solid reasons. HP gets more out of the ubiquitous 300-dpi Canon SX laser printer engine than anyone. With its proprietary Resolution Enhancement technology, the LaserJet III has the crispest graphics of any 300-dpi laser printer we've seen, and you get scalable fonts essentially for free (the LaserJet III sells for about the same as its predecessor, the LaserJet Series II). HP products are priced right, too. Imagine if Compaq were not only the best-regarded PC maker but also the cheapest. That's about what you have in the laser printer business.

Specialty printers. Finally, printer vendors are beginning to acknowledge all the markets that are ripe for special-purpose printers. Laser and ink jet printers offer B-size (11-by 17-inch) printing that creates monster spreadsheets, dramatic small-group wall charts, and high-resolution DTP masters (print them at 200 percent, then make a half-size offset plate to double the resolution). A half-dozen vendors boost resolution by tinkering with the controllers on 300-dpi and 400-dpi printer engines (Hewlett-Packard and LaserMaster) or engineering 600-dpi engines. Several products print envelopes or mailing-label tape only, perhaps enabling you to finally jettison the Selectric in the cubicle down the hall. And we're seeing an increasing number of higher-speed, 10- to 20-ppm printers meant to be shared by multiple users across a network. Six of the 47 lasers we review in this issue run at more than 10 ppm.

FONT TECHNOLOGY

For little or no more than you paid for your current laser printer, your next printer will be able to produce multiple typefaces

HOW WE TESTED THE PRINTERS

by Alfred Poor

With more than 700 printers reviewed in seven years, the *PC Magazine* Printer Project sets the standard for comprehensive comparative product reviews for the microcomputer market. You can use the information contained in this issue to compare the latest crop of printers with all the ones still on the market that we tested in the past, right back to the first batch in 1984.

Maintaining consistency—or backward compatibility, if you will—is important to us. Much of the testing process has remained essentially the same since the beginning: The text speed test still relies on the same two-page letter addressed to “Arthur D. Author” that we created the first year. This means that our character-per-second ratings remain comparable over the entire collection of reviews.

It's not easy to keep the playing field level over this length of time, especially in a market where the span between technological breakthroughs is measured in months, not years. For example, we discovered last year that an 8-MHz AT was not able to feed data to the faster laser printers as fast as they could accept it. This year, the problem has been eliminated by changing the standard PC Labs test-bed computer to the Compaq 386/25—at least until the next breakthrough in speed.

Another problem we faced is the Tower of Babel of printer command languages. When we started in 1984, it seemed as if every manufacturer had its own approach to Escape sequences. The dot matrix market then settled on Epson or IBM Proprinter commands as a widely accepted standard, but then the problem shifted to laser printers. Now we have grown to expect support for Hewlett-Packard's PCL (as used by the LaserJet family of printers) or Adobe's PostScript command language. This assumption still causes some problems, such as the LaserMaster printer which uses its own command language but is supported by *Windows* and *Ventura* (see the sidebar “The LaserMaster LM 1000: High Resolution at High Speed” for

additional information).

Now the polyglot problem focuses on a different class of printers: the ink jets. Some behave more like a dot matrix printer, others like a laser. Some print in black and white, others print in color. What commands should they answer to? As you'll see in the reviews, the jury is still out on what language approach is best for these printers.

The point is that we have had to build enough flexibility into the test programs so that we can adapt to the new command standards as they come along. Our fonts and features test, for example, has built-in support for dozens of the major command sets and related dialects. The program still permits the reviewer to enter additional commands by hand; this lets us get at extra fonts and added enhancements that may not be part of the basic emulation mode. We print the output from this test in the Fonts & Features tables that accompany each review.

In general, all of our test procedures are based on using hard-coded commands instead of applications. This helps us maintain consistency within the results without being affected by new versions of one program or another, or by the absence of a given driver from a specific application. The only exception to this is our graphics test: We use *Windows* to create output files for different printers from a one-page *PageMaker* document, but then these files are printed from within our test program, not *Windows*.

Why do we go to all this trouble? That's the easy part: We want to give you hard facts that you can rely on when making a buying decision. It's likely that you are going to keep your printer at least as long as your computer, so you want to get it right the first time. Here are some tips on how to use the information you'll find in this issue.

For everything but high-quality graphics, you are probably interested most in speed. For dot matrix printers, you'll find that our timings are about half the manufacturer's claimed speed.

CONTINUES

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HOW WE TESTED THE PRINTERS

CONTINUED

That's because we use our two-page letter, then figure the average speed over the two pages. Many printer vendors base their ratings on a "burst" speed, which is typically a measure of how fast the printer can write a short string of characters—often in a small pitch and in the lowest-quality print mode. This doesn't take into account the time required to execute carriage returns or paper advances. We report both draft and LQ speeds, with draft tested in the fastest mode the printer provides and LQ in the mode that gives the best-looking text. In other words, we give you speed tests that reflect a printer's fastest (often the worst quality) and best-looking (often the slowest) modes.

Laser printers run the same letter, but ten times, so we print 20 pages in all. This year we have also added a new laser speed measure: a "one-page out" time, reported in seconds. This test prints a page, then delays 30 seconds so that the printer's paper transport mechanism comes to a halt before the next page is printed. The time from the start of the new page until it drops in the output tray is recorded, and we then average the results over three trials. This will give you a relative measure of how fast each printer can produce a page. It is not a "first-page out" test, however, because there are many variables that can affect how long you have to wait for the first page. The first-page time will be different based on how long the printer has been idle, whether the printer was just turned on or reset, and the status of the printer's memory, especially the font cache on PostScript printers. Our test compensates for all these variables, however, so you get a consistent result that you can compare.

If you are looking for good graphics, you will be primarily interested in the output quality, but you will also want the best speed you can get as well. We report the times for the graphics speed test both in elapsed time in the Printer Guides preceding each section and in our own "graphics page per minute" (gppm) rating. Keep in mind that this

rating is based on printing our specific graphics page. While this gives a number that you can use to compare printers, your experience with any given printer will vary with the size and complexity of the image you print.

The emulation test results will alert you to problems a printer may have in interpreting the command set of the printer it intends to emulate; you'll find these "anomalous behaviors" discussed in the reviews. The emulation tests are essentially unchanged from last year, with one exception. Now that HP PCL has become the standard language for low-end laser printers, we decided to add a few more twists to our PCL "torture test" so that it now tests more complex commands sequences, such as nested macros. You'll find that not all the printers in our test group were happy with these changes.

The other main factor to consider is print quality. Our tests produce samples of both text and graphics, which are reproduced here as faithfully as we can manage, given the limitations of methods used to print magazines. If all you intend to do is print thousands of invoices or statements, you might not care that much about a printer's output quality as long as it is legible, but most applications require good text or graphic capabilities, or both.

One fact is certain: In the following pages you will find more printers than in any previous printer issue. You will find more features, broader performance ranges, and a greater span of list prices than ever before. And for every printer, you will find the hard numbers that help you find the one that is the best value for your needs—just like we've done six times before. ■

Editor's note: The creator of PC Labs' PCL torture test, contributing editor Alfred Poor, has participated in every printer issue since the first one in 1984. Only one other printer project participant, contributing editor M. David Stone, can make the same claim. This issue's "Inside" page honors our venerable printer project veterans.

infinitely scalable from speck-of-dust size to several inches high. Adobe's PostScript is the best-known contender. But PostScript isn't the only religion in town, as Microsoft and Apple are quick to tell you. There's TrueImage/TrueType from Microsoft and Apple, and there's also Intellifont—PCL 5's scalable font technology—in the HP LaserJet III. With immense stakes (and egos) involved, the issues are as much political as technical.

PostScript from Adobe Systems Inc. has been the best and pretty much the only way to get scalable fonts until now. Publishing professionals have loved PostScript because it works exactly the same on virtually every output device known to mankind, particularly high-resolution phototypesetters. But, in the eyes of much of the world, PostScript was too slow. Also, Adobe charged too much for licenses and kept PostScript very proprietary. So last year, Microsoft and Apple united to announce a competing font technology: TrueType, a font technology from Apple (it's also called Royal) and TrueImage, a page description language developed by Microsoft and Bauer Enterprises (now part of Microsoft).

TrueType/TrueImage incorporates PostScript scalable-font concepts for printers and is backward-compatible with PostScript fonts. It automatically provides matching fonts on-screen (similar to Adobe's Display PostScript) and does everything faster, better, and smarter than PostScript—or so say Microsoft and Apple. TrueType/TrueImage will be available in *Microsoft Windows*, OS/2, and on the Macintosh, but you'll also be able to get it in other ways: by having it built into your own printer, by simply plugging in TrueType/TrueImage cartridges, or, alternatively, by using it as a software layer only, like *Adobe Type Manager*.

Shortly after the Microsoft/Apple slam dunk on PostScript last year—and as competitors announced they'd cracked the PostScript encryption routines—Adobe published many of the PostScript Type 1 font specifications (Type 1 is Adobe's good font collection), cut its prices, and announced a PostScript 2 superset (PostScript 2 printers are due in early 1991) that should address many of the speed issues. To further muddle the mess, IBM lives in both camps. Big Blue supports a common Microsoft/IBM implementation of the OS/2 Presentation Manager, which means TrueType. But IBM also says that PostScript and *Adobe Type Manager* will be

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OUR CONTRIBUTORS

Mario Baldasserini is a system support specialist at PC Labs.

Karen Best is an assistant editor of *PC Magazine*.

Kellyn S. Betts is an associate editor at *Mechanical Engineering* magazine and a frequent contributor to *PC Magazine*.

Robin B. Bornstein is an editorial assistant of *PC Magazine*.

Bruce Brown is a contributing editor of *PC Magazine*.

David Dean is a columnist for *PC Publishing Magazine* and is the author of *Using Microsoft Word for Windows* (Osborne/McGraw-Hill).

Carolyn Falconer is a lab assistant at PC Labs.

Meredith M. Gadsby is an editorial intern of *PC Magazine*.

Ron Goldberg is a nationally syndicated writer and director of the New York Center for Electronic Music.

Bill Howard is an executive editor of *PC Magazine*.

Carol Levin is a staff editor of *PC Magazine*.

Edward Mendelson is a contributing editor of *PC Magazine*.

Bill O'Brien is a contributing editor of *PC Magazine*.

Ed Perratore is a frequent contributor to *PC Magazine*.

Margaret Piemonte is a lab assistant at PC Labs.

Stephen W. Plain is a system support specialist at PC Labs.

Alfred Poor is a contributing editor of *PC Magazine*.

John R. Quain is an associate editor of *Video Review* magazine and a frequent contributor to *PC Magazine*.

Oliver Rist is an assistant editor of *PC Magazine*.

Joseph F. Rizzo is the network manager of *PC Magazine*.

Winn L. Rosch is a contributing editor of *PC Magazine*.

Matthew J. Ross is a staff editor of *PC Magazine*.

Ann Sherman is a staff editor of *PC Magazine*.

Luisa Simone is a contributing editor of *PC Magazine*.

M. David Stone is a contributing editor of *PC Magazine*.

Susan G. Thomas is an editorial intern of *PC Magazine*.

Tom Unger is a staff editor of *PC Magazine*.

Nathaniel Zelnick is an editorial assistant of *PC Magazine*.

the vehicle for sharing documents across its entire product line and that *Adobe Type Manager* will be built into future IBM printers.

In the meantime, through Intellifont, HP's PCL 5 provides the same scalable fonts in a popular, proven product: the HP LaserJet III and the new, duplex-printing LaserJet IID. (All other HP-compatible printers reviewed in this issue use PCL 4, the version in the LaserJet Series II.) Intellifont was developed jointly between Hewlett-Packard and AGFA Compu-graphic, a maker of high-resolution phototypesetters. AGFA hopes, possibly against hope, that Intellifont will make a run against PostScript in the professional publishing arena. Whether it does or not, PCL 5 is already a force to be reckoned with in the office market because HP accounts for nearly half of the laser printer sales. Since Intellifont/PCL 5 comes in the LaserJet III, you get scalable Times

Roman-like and Helvetica-like fonts as well as the ability to add more through font cartridges or downloadable soft fonts.

For users, the best thing about the font wars is that it's hard to make a wrong buying choice because most printers you buy can be adapted to another font and page description technology if the winds change. This isn't like the Beta versus VHS issue of the 1970s, where the wrong VCR buying choice meant you couldn't rent movies two years later. For instance, with current and previous-generation HP printers (LaserJet III or Series II), you can buy a PostScript cartridge from HP or Adobe or a third party, upgrade your printer's memory (typically you'll need 1.5MB total for letter-size printing), and be in business for a little over \$500 street price. You can get a taste of PostScript with *Adobe Type Manager* for less than \$100, and you'll get TrueType with the next version of *Windows*. Moreover, many

other printer vendors will also offer PostScript upgrades. Bitstream has already launched an ATM compiler called *Facelift* that provides on-the-fly screen and printer font scaling for *Windows*.

Look for font and page description technology to seek dominance over other communications standards, starting with fax machines. Versions of these technologies are being proposed as standards for e-mail graphics, and there's even talk of PostScript and TrueImage driving graphics on high-definition television sets of the 1990s. If the eventual goal is to deliver the same image to any output device—not just a printer loaded with 8.5- by 11-inch paper—then that's not as wild as it might sound.

MULTIFUNCTION PERIPHERALS

Recall ShopSmith, the combination drill press, lathe, and saw? Apply that concept to PC printers and you've got a multifunction peripheral, or MFP. Based around a laser printer or photocopier engine, the device could include a printer, scanner, photocopier, fax, and a voice/fax/data phone-line switcher. Prices? Anywhere from \$1,000 for a board that sits in your PC and links, hydra-like, your existing laser printer, scanner, and fax board or fax machine up through \$15,000 for a self-contained 15- to 20-ppm device with a rugged duty cycle. A mainstream product might cost \$5,000, not much more than the price of a good, standalone plain-paper fax machine. Products have been announced or reported from Xerox, Panasonic, Ricoh, Canon, Olivetti, Goldstar, Samsung, Okidata, and Elite High Technology.

ENVELOPE PRINTERS

Envelope printing remains a bottleneck in the office. Envelope-tray attachments are partial solutions, as are stick-on labels if you can live with the mass-mailing image. Several vendors now offer printers designed just for envelopes. Some are high-end network devices that print 2,000 plus envelopes per hour and can print ZIP codes a second time in bar-code format, giving you a break on mailing rates. Companies include Rena Systems (King of Prussia, Pennsylvania), Scriptomatic (West Consohocken, Pennsylvania), and Bryce Office Systems (Oxford, Connecticut). At the low end is Seiko's SmartLabel printer, selling for \$250. It prints address label strips. We'll look at these specialty products in an upcoming issue.



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BUYING TIPS

by Bill Howard

In the Editor's Choice boxes, we'll tell you which printers are your best choices in 1990. Here's some general buying advice that applies no matter what brand you choose:

- Personal laser printers (4- and 6-ppm) produce graphics almost as quickly as 8-ppm laser printers. If you're doing desktop publishing on a budget, you're better off with a 4-ppm laser printer with PostScript than an 8-ppm PCL-only printer with a batch of font cartridges and soft fonts.

- Spending a few dollars more for a dot matrix printer buys not only faster throughput but more intelligently laid out front-panel switches and better paper handling. Sometimes that's more important than the extra 25 characters per second.

- If your dot matrix printer offers an optional cut-sheet feeder, get it. You'll never have to rip and de-perf tractor-feed paper again.

- If you're doing graphics, order your laser printer with 1MB to 2MB total memory. To run PostScript (if you buy a plug-in PostScript cartridge), you'll typically need 1.5MB total memory (including the amount that came with your printer), 2MB if you're printing on legal paper. This is memory that goes in your printer, not your PC. To save money, compare the price of third-party memory modules with those of the printer vendors. Until recently, you could pay twice as much for essentially the same RAM chips; now there's much

greater pricing parity.

- Look for HPGL (Hewlett-Packard Graphics Language) plotter emulation in your laser printer if you're doing graphics or CAD. Graphics can print several times faster when the image is sent as a vector image (lines) under HPGL than as a bitmap (hundreds of thousands of pixels) under LaserJet PCL. The latest version, HPGL/2, is built into PCL 5 and some software.

- Dual PostScript/PCL printers vary in the ease with which they switch emulations. The QMS PS-410 sets the standard: its Emulation Sensing Processor (conveniently abbreviated ESP) automatically detects the vastly different data streams of PCL, PostScript, and HPGL.

- If you're shopping for rock bottom prices on laser printers, find out if the price includes the toner cartridge. It should; sometimes it doesn't, and that can explain why one dealer is \$75 cheaper than a competitor.

- The 4-ppm Canon LX engine-based personal laser printers (Apple Personal LaserWriter, Canon LBP-4, LaserJet IIP, etc.) have only 50-sheet paper trays. Figure in an extra \$195 (list) for the 200-sheet bottom-feed tray when you're comparison shopping against some of the competing 4- and 6-ppm laser printers with 200-sheet trays built in.

- Some laser printers (most introduced before this year, some still available) have proprietary font-scaling technologies—not PostScript, not PCL 5. If they can't be modified to accept other

font technologies, they're dead ends.

- The most valuable utility you buy this year, if you use *Microsoft Windows*, may be *Adobe Type Manager*, the \$99 software implementation of PostScript for your display, your laser printer, and your dot matrix printer. To get the full 35 typefaces (11 different type families) found in most PostScript printers, you'll also need the \$199 Adobe Plus Pack.

- HP offers a motherboard upgrade to turn your LaserJet Series II into a LaserJet III for \$1,200; in most cases, the math doesn't work out. You're better off buying a new laser printer and passing the old one down to someone else in your department.

- Perhaps the most efficient way to network a printer is with a self-contained network print server peripheral node, a modem-size device that contains the equivalent of a self-booting PC, a network card, and a parallel and serial port. Clip the box to the side of your printer, attach three cables (network, printer, power), run a setup routine from the system administrator's PC, and you're in business. Vendors include Castelle (Lanpress), Intel (NetPort), and Microtest (LANPort). Cost: \$500 to \$800 list. If you aren't networked and just want to hook a handful of PCs to a printer, look into electronic switching devices from companies such as Fifth Generation Systems, Buffalo Products, Digital Products, Baytech, 3X USA, Rose Electronics, and several dozen others. ■

COLOR POSTSCRIPT

Last year and for the first time, we added high-end color PostScript printers to the special issue on printers (see "Color Page Printers: Affordable At Last," November 14, 1989). We tested five printers priced between \$8,000 and \$16,000 that produced spectacular color output for high-end desktop publishing and boardroom presentations: the Howtek Pixelmaster, the QMS ColorScript 100 Models 10 and 30, the Seiko Instruments CH-5504-PS, and the Tektronix Phaser CP. This year, QMS, Seiko, and Tektronix have intro-

duced new models, and NEC and Océ Graphics have entered the market. Look for a roundup of these high-end PC printers in an upcoming issue.

REVIEW CRITERIA

The 121 printers in this issue represent virtually every new printer of the past year. PC Labs' review criteria were simple: If it prints on a PC, came to market since our November 14, 1989, printer issue, and it was in our hands by the early summer, it was eligible for review. We asked vendors to supply not only their printers but

the frequently requested options. We especially wanted to see sheet feeders that added versatility to dot matrix printers, color ribbons on dot matrix printers, and PostScript or PostScript emulator boards and cartridges on laser printers. If a printer supports both PostScript and PCL, we tested it both ways. To find out more about adding PostScript to your laser printer, see the sidebar "How to Transform Your LaserJet into a High-Flying PostScript Machine" in the laser review section.

Plotters have been reviewed separately

In Redondo Beach, California . . .

You'll find breathtaking ocean views, sensational surfers and Gateway 2000 computers.

Dive 'N Surf, famous for Body Glove® fashions and watersports equipment, is a



Graham Pask, Computer Systems Manager for Dive 'N Surf, and his Gateway 2000 25 MHZ 386 network server.

member of the growing family of Gateway 2000 customers in California. Dive 'N Surf Computer Systems Manager Graham Pask chose a Gateway 25 MHZ 386 machine for his network server. The system runs point-of-sale, inventory control, word processing and desktop publishing software.

"I decided to buy a Gateway 2000 system because they had everything I wanted for a good price," said Graham. "But what really impressed me was the service. I had a problem with my 3 1/2 inch drive so they sent me a new drive the very next day."

Graham said he was so happy with his Gateway system at work that he bought a Gateway 2000 25 MHZ 386 Cache machine for his home.



"You've got a friend in the business."

Until well after sunset, surfers ride the big waves on the Pacific Ocean near Redondo Beach, California.



And In Barrow, Alaska . . .

Over 300 miles north of the Arctic Circle, you'll find polar bears, seals, whales, walrus, lemmings, snowy owls and what appear to be the largest mosquitoes in existence. On a summer afternoon you'll also see parka-clad tourists

walking among local residents in shorts. And of course you'll find a good Mexican restaurant and Gateway 2000 computers.

Cape Smythe Air Service, a regional commuter airline serving Barrow, Kotzebue, Nome and remote villages in Alaska, has one of several Gateway 2000 computers operating in Barrow. Jeff Frier, Cape Smythe's accountant, chose a Gateway 2000 386SX to

run spreadsheet, data base and accounting applications.

"I was trying to decide between Gateway 2000 and a competitor," Jeff commented, "so I talked to a person who owns the competitor's system. He was disgruntled about the service he received from them. Then I talked to another person in Barrow who has a Gateway and she was happy with the product and service. The choice was pretty obvious -- when you're doing business in a remote area, the most important things a vendor can offer are reliability and good service."

Jeff said he also appreciated Gateway's features and price. "When you have to pay \$6 a gallon for milk, it's nice to find a bargain somewhere." Jeff plans to buy another Gateway 2000 computer in a few months.



Jeff Frier, Cape Smythe Air Service, with his Gateway 2000 386SX.

On a mid-July day in Barrow, Alaska, fishing boats weave in and out of icebergs on the Chukchi Sea.



Near Camp Verde, Texas . . .

You'll find the magnificent Hill Country of Texas with rattlesnakes, prickly pear cactus and huge cattle ranches. You'll also find Larry Mahan and his Gateway 2000 computer.

Larry Mahan is to rodeo what Jack Nicklaus

is to golf. He is Six Times World Champion All-Around Cowboy and is a member of the Cowboy Hall of Fame. But Larry also runs a cattle and horse ranch and is involved in a western apparel manufacturing company and a new Southwestern foods company. His Gateway 2000 20 MHz 386 system is an integral part of his business operations. "We run cow and calf software for

our Longhorn cattle herd," Larry said. "You can't really manage a livestock business efficiently without it. Plus we do accounting, spreadsheets and word processing on our Gateway 2000 computer."

Asked why he chose Gateway 2000, Larry said, "They had the best features and price – and I thought a computer company that puts pictures of cattle in their ads had to be my kind of people. And I was right. The people I've talked with at Gateway 2000 are honest-to-goodness nice folks. It's a pleasure doing business with them."



*Larry Mahan, rodeo star, and his
Gateway 2000 20 MHz 386 system.*



Larry Mahan raises registered Texas Longhorn cattle.



In Bradford, Pennsylvania . . .

You'll find a charming small city nestled in the Allegheny National Forest. The city's most prominent local business is the Zippo Manufacturing Company, where you'll find 18 Gateway 2000 computers in use.



Fred Gronemeyer, Zippo Manufacturing Company, and his Gateway 2000 20 MHz 386 system.

Zippo is known around the world for its windproof lighter made famous during the second World War, although today the company's product line includes many other specialty advertising items. Fred Gronemeyer, Systems Analyst for Zippo, chose Gateway 2000 as the company's standard PC.

"We needed to set standards for PC's and software to make the most efficient use of these tools," Fred remarked. "We started out with PC's from different manufacturers, but once I tried Gateway I was convinced we could get the highest quality, most reliable machines at the best price from Gateway 2000. I was also impressed by my salesman and the tech support people I've dealt with at Gateway."

Fred said by the end of the year Zippo will be running every system Gateway 2000 makes, from 286's up to a 486 and everything in between.

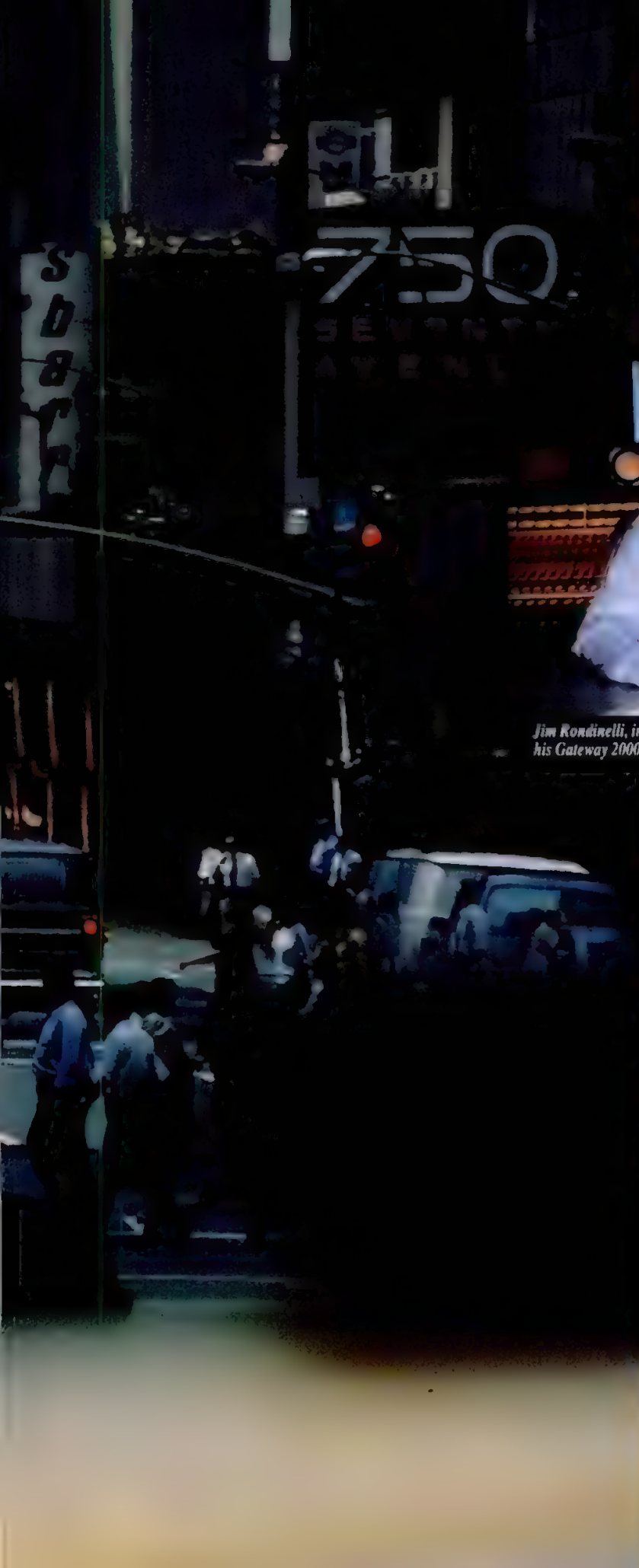
Main Street, U.S.A., is located in Bradford, Pennsylvania.



And In New York City . . .

You'll find your senses overwhelmed by the countless sights and sounds of this one-of-a-kind city. And of course you'll find thousands of Gateway 2000 computers here.

One New York City Gateway 2000 owner is



Jim Rondinelli, independent record producer and engineer, with his Gateway 2000 386SX.

independent record producer and engineer Jim Rondinelli. Jim uses his Gateway 2000 386SX with a sophisticated player piano sequencer to compose music.

"The software I use is written for the Mac and for IBM compatibles," Jim said, "but it runs much better on IBM compatibles. And it runs best of all on my Gateway. I travel often and I've used my software on a lot of other machines. They don't even compare with my Gateway 2000."

Jim said he bought his Gateway 2000 because it was equipped for the real world with ample hard drive capacity and RAM, both sizes of disk drives and color VGA graphics.

"It's the fastest file transfer computer I've ever used," continued Jim, "plus it ran right out of the box. One afternoon and I was fully functional on a brand new system."

The streets of Manhattan are a constant blur of activity.

ACROSS THE COUNTRY YOU'LL FIND



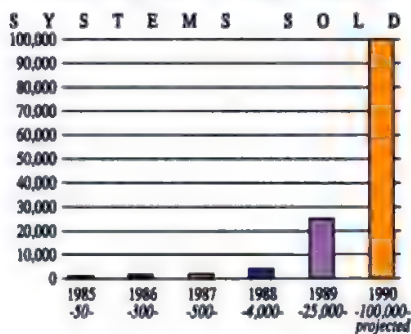
You'll find so many Gateway 2000 computers in so many places today because people everywhere know a good value when they see one. In all 50 states and in over 70 foreign countries, thousands of people are comparing prices, quality and service – and choosing Gateway 2000.

But value alone doesn't explain how a little company in the Midwest, started just five years ago, managed to outdistance hundreds of other companies, selling more systems through the direct market channel today than any other PC manufacturer in the country.

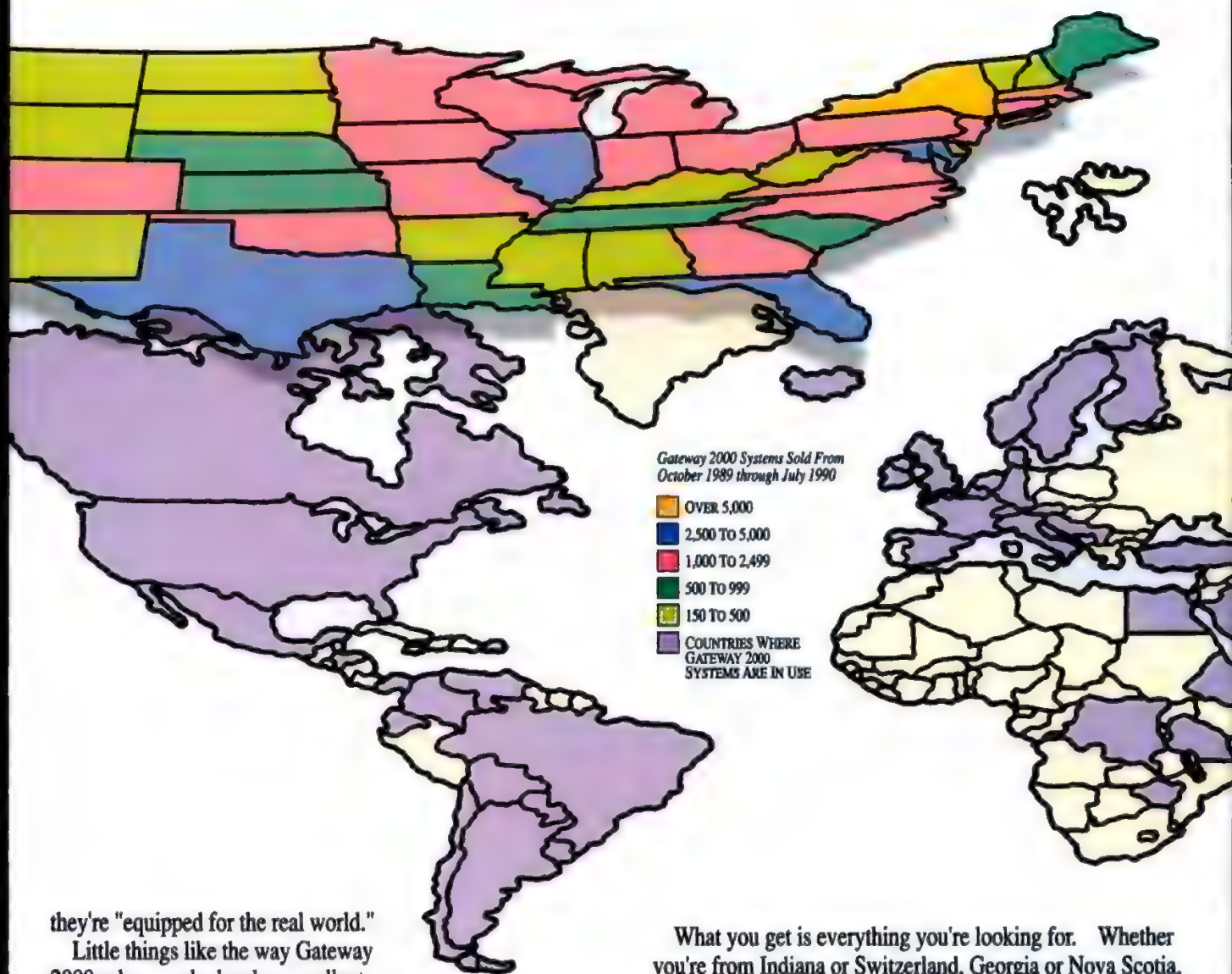
The explanation is that the company has always maintained a small company attitude. With Gateway 2000, you still get the little things you'd expect only from a small firm.

Little things like a positive technical support department. When Graham Pask told his Gateway 2000 tech rep that his 3 1/2" drive didn't work, he received a new drive the very next day.

Little things like the way Gateway 2000 systems are fully loaded with all the features you want. Jim Rondinelli bought a Gateway 2000 computer because



AND AROUND THE WORLD, GATEWAY 2000!



they're "equipped for the real world."

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HOW TO READ THE PRINTER GUIDE AND TABLES

For a quick look at the printers reviewed in this issue, turn to the *PC Magazine Printer Guide* preceding each section. In the Guide, you'll find the results of PC Labs' tests and a listing of each printer's most important features, its price, and samples of both text and

Text Speed

Rather than relying on the rated speed supplied by each printer manufacturer, PC Labs timed each printer's text and graphics output speeds. For laser printers, the reported text speed tells you the rate in pages per minute (ppm) at which each model printed out ten copies of our Arthur D. Author test—a two-page, single-spaced business letter. For dot matrix printers we printed one copy of our Arthur D. Author document; the unit of measurement is characters per second (cps). Two speeds are given for dot matrix printers: one based on the printer's performance in draft mode, the other based on its best or nearest-to-letter quality mode. See the 3-D bar chart in each section for relative printer speeds.

HP LaserJet III

Canon SX engine-based 8-ppm laser printer with scalable fonts and Resolution Enhancement. Accepts HP-compatible cartridges and soft fonts. Adobe PostScript option available.

TEXT SPEED: 7.5 ppm
ONE PAGE OUT: 19 sec.
GRAPHICS SPEED: 1.9 gppm
GRAPHICS TIME: 0 min. 32 sec.

Graphics Speed

Our graphics output test doubles as our graphics speed test. In addition to reporting the actual time each printer took to output the scanned photo, we've converted that time to a rate we've named graphics pages per minute (gppm). For a quick comparison of speeds, turn to the 3-D bar chart in each section.

One-Page Out Speed

The "one-page out" time reports, in seconds, the time from the start of the new page (with the printer at idle for 30 seconds) until the page drops into the printer's output tray. This gives you a relative measure of how fast each laser printer can produce a single page. The time is an average of three trials.

Graphics Output: Scanned Half-tone Image

At PC Labs, we tested each printer's ability to handle graphics output with this scanned photo, which was taken specifically for the test and contains many shades of gray. We've included it to make it easy for you to compare the printers' half-tone output, but we don't recommend printing photos with dot matrix printers.

Graphics Time

To find out how long you'll have to wait for each of the printers to output a typical graphic image, take a look at how long it took to print our scanned photo, reported here in minutes and seconds

Graphics Output: Line Art

In addition to our scanned photo, these lines appear on our test graphics page. They show you how each of our printers handles lines of varying widths, as well as curved lines

in other issues, most recently in "Desktop Plotters Face the Competition" (March 27, 1990). For a look at high-resolution speed-up boards that typically reside inside your PC and send completed pages to your printer by a special interface cable, turn to "High-Resolution Printer Boards: Looking Great for Less" (April 24, 1990). Keep a lookout for articles on two speciality printer categories—envelope printers and color PostScript printers—in upcoming issues.

Fonts & Features

Each printer is accompanied by a Fonts & Features table that shows you what features or enhancements are available with each font offered under one emulation.

For laser printers we've shown what features are available with four common fonts—Helvetica, Times, Courier, and Line Printer—in four different point sizes—8/9, 10, 12, and 14. Since many printers in our roundup let you choose a font in any size you want, we've also included a Scalable category. Please note that for some printers, what we call a feature (the bold enhancement to the Courier font, for example) is actually a separate font—called *Courier Bold* in HP-ese.

For dot matrix printers, we've shown what features are offered at four widths: 10 characters per inch (10 cpi, or 10 pitch), also known as *pica*; 12 cpi, or 12 pitch, also known as *elite*; *compressed*, somewhere between 15 and 20 cpi; and *proportional*, which lets narrower characters, such as *i* take up less space than wider characters, such as *w*.

Fonts & Features

Hewlett-Packard LaserJet III

HP LaserJet Series II

	Helvetica	Times	Courier	Line Printer
Underline				
Sub-Super				
Italic				
Bold				
8/9-point				
10-point				
12-point				
14-point				
Scalable				

For samples of some of the fonts and features for each printer, see the text output in the *PC Magazine Printer Guides*.

Gray-Scale or Color Output

In the *PC Magazine Printer Guides* we've included six shades of gray output from each printer. We've also reproduced a portrait photo using standard magazine reproduction techniques; comparing the way each printer reproduces this sample photo via a scanned image will give you a good sense of how each printer handles half-tones. Look at the six versions of half-

tone output to see how the printer handles distinct shades of gray.

For color-capable printers, we've included the results of our color test. To see how each printer handles color, take a look at how it prints the six colors in our test: blue, red, magenta, green, cyan, and yellow.

Text Output

To see how the text output from each of our printers compares, read the quote from Leo Tolstoy that offers a sample of fonts and features. And for a list of which

features are available with fonts under certain emulations, see the Fonts & Features table accompanying each review



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an 8-ppm (claimed) laser printer actually running at 7 ppm operates at the equivalent of 350 cps. It's important to note that laser printers don't produce pages any faster if there's less text on the page, so the same 7-ppm printer might produce double-spaced text at the rate of 150 to 200 cps. Of special interest to laser printer owners: We've added a new test that indicates the time it takes to deliver the first page of output.

The graphics test continues to be the same as the one in the 1989 printer issue: a scanned head-and-shoulders portrait. It's important to note that text and graphics speed are often unrelated on laser printers, and many 4-ppm laser printers are able to handle graphics just as quickly as 8-ppm printers can.

That means, for instance, if you're doing desktop publishing, you may be better off buying the cheaper printer and investing the \$750 savings in a PostScript cartridge option and extra printer memory. We use the graphics test on dot matrix printers as well, although it's for speed comparison primarily and not because we believe that you can print acceptable half-tones on a dot matrix printer.

ISSUE LINEUP

This printer issue is arranged in three sections by printer type. From front to back, the order is laser (and similar) printers, ink jet printers, and dot matrix printers (both color and monochrome varieties). Each of these sections has an introduction that highlights key issues, a guide for quick comparisons and output samples, and—for the first time in a printer issue—3-D charts of text and graphics speed test results.

As in years past, we include an index of printers reviewed by PC Labs in previous printer issues that are still available. The index lists printer type, highest tested speed (not the vendor's often inflated speed claim), current price, and the issue and page number of the review.

With this issue, *PC Magazine* has reviewed 713 printers: 120 in 1984; 70 in 1985; 97 in 1986; 106 in 1987; 90 in 1988; 109 last year; and now 121 this year. Statistically, you're most likely to wind up spending your money on an HP LaserJet laser printer or an Epson dot matrix printer. But you'll find some interesting alternatives on these pages that bear close consideration. ■

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Great Teams



Top, left to right: Amelia Earhart and her Lockheed Vega; Sherlock Holmes and Doctor Watson; Orville and Wilbur Wright. Bottom, left to right: Bonnie Parker and Clyde Barrow; 1980 American Olympic hockey team.

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PC Labs tests 47 laser printers. This year's good news is better output, faster speeds, and lower prices than ever before.



BY M. DAVID STONE

As the old saw has it, the more things change, the more they remain the same. This year's laser printer story tells some familiar tales. Prices are down, and print quality and print speed are up, LaserJet emulation reigns supreme, and Postscript—as well as Postscript clones—are on the rise. Behind these sweeping trends, though, are some exciting details.

Forty-seven page printers—based on laser, LED, and LCS engines—showed up at PC Labs in time for this review. The big news this year is Hewlett-Packard's HP LaserJet III and the recently released, duplex-

printing HP LaserJet IIID, which provide both PCL 5, the current generation of HP's laser printer control language, and Resolution Enhancement, which yields visibly better output even within the context of 300- by 300-dpi printing.

Expect other vendors to move up to LaserJet III's new font-scaling PCL 5 command set by early 1991. (As of this issue, only the two HP LaserJet III machines have PCL 5.) But widespread emulation of HP's proprietary Resolution Enhancement will take longer. For now, Resolution Enhancement keeps Hewlett-Packard one giant step ahead of the pack (see the sidebar "The Latest in Laser Language: PCL 5" for more information.)

LOW END: \$1,000 STREET PRICES

At the low end of the market, the big news is that there is no new big news. Just more of yesterday's big news. Last year, the 4-ppm HP LaserJet IIP made a splash as the first laser printer designed to sell at a \$1,000 street price. When we looked at low-end lasers earlier this year, there were ten with list prices at \$1,700 or less (see "A \$1,000 Laser for Every Desktop," June 12, 1990). Now, there are four more: the Brother HL-4, the Fujitsu RX7100 S/2, the Olivetti PG 306, and the Panasonic KX-P4420. The upshot is you should be able to find a laser at \$1,000 or less without even trying.

Most of these low-end lasers offer text speeds of 4 ppm or 6 ppm. In many cases, it's only the text speed that suffers in comparison to 8-ppm printers; for graphics, the cheaper printer engines aren't far behind in speed. With 5-ppm speed, 200 sheets of paper standard, and an affordable PostScript option, IBM's new LaserPrinter E is the most promising low-end laser. While you're shopping at the low end, be sure to keep an eye out for the Panasonic KX-P4420, an 8-ppm printer that should also be available for under \$1,000.

Many of these low-priced lasers are built around the 6-ppm TEC 1305 engine, and are virtually identical. These have become commodity items, so look for the least expensive and don't pay more than \$1,000 unless you're getting something more—like memory beyond 512K.

HIGH-END SPEED

The market's high end puts its emphasis on speed. Dataproducts, Kyocera, and

QMS all offer high-speed lasers. As in previous years, most of the mainstream, mid-price printers have engines rated at 8 ppm, though there are a few mavericks with ratings of 10, 11, or 12 ppm. Panasonic has had good luck selling its workhorse 11-ppm KX-P4450i at a price approaching that of many 8-ppm printers.

Expect vendors to move up to the LaserJet III's new font-scaling PCL 5 by early 1991. Widespread emulation of HP's Resolution Enhancement will take longer.

Variations in print quality have all but disappeared among standard 300-dpi printers. Gone are the days when a goodly percentage of laser output looked like second generation copy produced by a poorly-maintained office copier. All the most common engines—including the 6-ppm TEC 1305 and 4-ppm Canon LX that dominate low end printers—produce dark, crisp text characters, and solid black areas on graphics. So do most of the less common engines, including, for example, the two Matsushita engines in the Panasonic KX-P4420 and KX-P4450i. Even if you have a keenly critical eye, you'll have an easier time finding acceptable output than in past years.

HIGH-QUALITY OUTPUT

Virtually every laser printer in this overview offers compatibility with the LaserJet Series II, Adobe PostScript, or both. The two holdouts are DEC and Canon.

Canon lacks LaserJet emulation because of a marketing agreement with Hewlett-Packard, which almost certainly sells more Canon-based printers than Canon does. However, Canon now offers an Adobe PostScript cartridge for the Mark III, and expects to have one for the LBP-4 shortly—possibly by the time this issue is published. And, Canon includes the Diablo 630 emulation.

DEC, on the other hand, offers only a

proprietary emulation, which is why we've put the two DEC lasers in a sidebar. Even DEC offers a PostScript-compatible print utility that runs on a VAX (for those who have them). And DEC is promising a PostScript-compatible cartridge in the near future.

On the PostScript front, both PostScript and PostScript equivalents like RIPS and Bauer PDL are increasingly common, particularly as optional add-ons at extra cost (see the sidebar "How to Transform Your LaserJet into a High-Flying PostScript Machine"). Prices have dropped significantly, with the PostScript options in the HP LaserJet IIP and IBM LaserPrinter E serving as the Joneses with whom other vendors must keep up. You should be able to add PostScript abilities to many laser printers for about \$500 (street price), including the usually required extra megabyte of printer memory.

The HP LaserJet IIP Adobe PostScript option is \$695 list plus \$335 for an extra megabyte of RAM (if you buy HP-supplied memory chips), yielding a total system list price of \$2,525 for a printer that follows LaserJet Series II and PostScript commands. Expect the street price to be about \$1,600. The PostScript option for the IBM LaserPrinter E costs \$449 plus \$449 for the additional megabyte, yielding an even lower total-system list price of \$2,393 and a street price well under \$2,000.

Note that printers differ markedly in their ease of switching between PCL and PostScript modes. On some machines, such as Hewlett-Packard's printers, you have to reset the machine in order to make the switch. Perhaps the most elegant solution belongs to QMS. The Emulation Sensing Processor (ESP) on the 4-ppm QMS PS-410 knows what the control codes for PCL and PostScript look like, and adjusts the printer automatically.

Did we say that the more things change the more they stay the same? Well, maybe things have changed after all. Those of us who were around for the first PC printer projects can remember when \$5,000 for a laser printer was a breakthrough, and when some manufacturers thought that an Epson emulation ought to reproduce a 9-pin dot matrix character on the laser-printed page. And if you want even more change—well, as the Dodgers used to say, before they moved to Los Angeles, "Just wait till next year."

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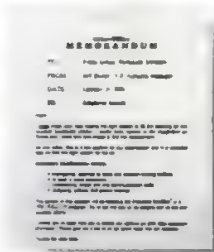
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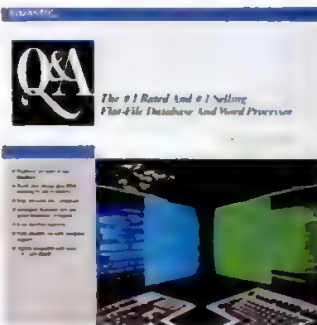
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CIRCLE 344 ON READER SERVICE CARD

Apple Personal LaserWriter NT

\$3,299

Canon LX engine-based 4-ppm Adobe PostScript laser printer with HP LaserJet Series II compatibility. Does not accept HP cartridges but does accept HP-compatible soft fonts.

TEXT SPEED: 3.9 ppm
ONE PAGE OUT: 36 sec.
GRAPHICS SPEED: 0.07 gppm
GRAPHICS TIME: 14 min. 0 sec.



Man's mind cannot grasp the
of events in their complete
but the desire to find the cause
is implanted in man's soul.
Courier Bold Underline
Palatine Bold Underline

Brother HL-4

\$1,495

Canon LX engine-based 4-ppm HP LaserJet Series II-compatible laser printer. Accepts both HP-compatible cartridges and soft fonts.

TEXT SPEED: 3.8 ppm
ONE PAGE OUT: 33 sec.
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME: 0 min. 53 sec.



Man's mind cannot grasp the
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is implanted in man's soul.
Courier Bold Underline
Line Printer Bold Underline Co

Canon LBP-4

\$1,545

Canon LX engine-based 4-ppm CaPSL laser printer with scalable fonts. Does not accept HP-compatible cartridges or soft fonts but does accept proprietary font cards.

TEXT SPEED: 3.9 ppm
ONE PAGE OUT: 34 sec.
GRAPHICS SPEED: 0.9 gppm
GRAPHICS TIME: 1 min. 4 sec.



Man's mind cannot grasp the
of events in their complete
but the desire to find the cause
is implanted in man's soul.
Dutch Bold Underlined Co

Canon LBP-8 Mark IIIR

\$3,795

Canon RX engine-based 8-ppm CaPSL duplexing laser printer with scalable fonts. Does not accept HP-compatible cartridges or soft fonts but does accept proprietary font cards.

TEXT SPEED: 7.4 ppm
ONE PAGE OUT: 20 sec.
GRAPHICS SPEED: 1.0 gppm
GRAPHICS TIME: 1 min. 1 sec.



Man's mind cannot grasp the
of events in their complete
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is implanted in man's soul.
Dutch Bold Underlined Co

Dataproducts LZR 650

\$1,695

Sharp engine-based 6-ppm HP LaserJet Series II-compatible laser printer. Does not accept HP-compatible cartridges but does accept proprietary font cards and HP-compatible soft fonts.

TEXT SPEED: 6.4 ppm
ONE PAGE OUT: 18 sec.
GRAPHICS SPEED: 1.3 gppm
GRAPHICS TIME: 0 min. 48 sec.



Man's mind cannot grasp the
of events in their complete
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is implanted in man's soul.
Courier Bold Underline
Line Printer Bold Underline Co

Dataproducts LZR 2450 D

\$19,995

Kentek K4 engine-based 24-ppm HP LaserJet Series II-compatible LED printer. Does not accept HP-compatible font cartridges but does accept HP-compatible soft fonts.

TEXT SPEED: 18.3 ppm
ONE PAGE OUT: 9 sec.
GRAPHICS SPEED: 3.6 gppm
GRAPHICS TIME: 0 min. 17 sec.



Man's mind cannot grasp the
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is implanted in man's soul.
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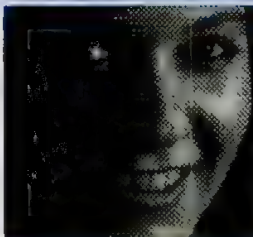
PRINTERS LASERS

Everex Abaton LaserScript

\$2,995

TEC engine-based 6-ppm laser printer with Microsoft/Bauer PostScript emulator and HP LaserJet Series II compatibility. Accepts HP-compatible font cartridges and soft fonts.

TEXT SPEED: 5.9 ppm
ONE PAGE OUT: 29 sec.
GRAPHICS SPEED: 0.3 gppm
GRAPHICS TIME: 3 min. 46 sec.



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Relatine Bold Underline

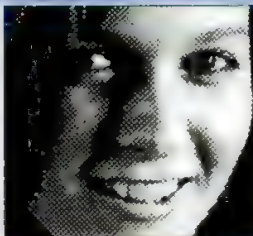


Facit P6060

\$1,599

TEC engine-based 6-ppm HP LaserJet Series II-compatible laser printer. Accepts both HP-compatible cartridges and soft fonts.

TEXT SPEED: 5.7 ppm
ONE PAGE OUT: 25 sec.
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME: 0 min. 55 sec.



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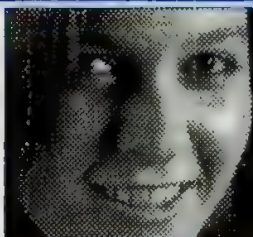


Fujitsu RX7100PS Plus

\$2,700

Fujitsu M3701M engine-based 5-ppm Adobe PostScript LED printer with HP LaserJet Series II compatibility. Only accepts proprietary font cards and HP-compatible soft fonts.

TEXT SPEED: 5.3 ppm
ONE PAGE OUT: 18 sec.
GRAPHICS SPEED: 0.6 gppm
GRAPHICS TIME: 1 min. 44 sec.



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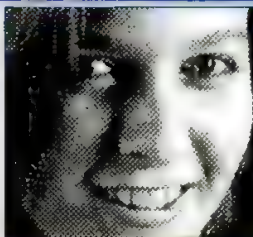


Fujitsu RX7100 S/2

\$1,925

Fujitsu M3701M engine-based 5-ppm HP LaserJet Series II-compatible LED printer. Does not accept HP cartridges but does accept proprietary font cards and HP soft fonts.

TEXT SPEED: 5.3 ppm
ONE PAGE OUT: 13 sec.
GRAPHICS SPEED: 1.5 gppm
GRAPHICS TIME: 0 min. 40 sec.



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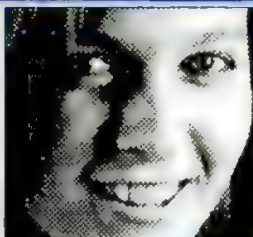


HP LaserJet III

\$2,395

Canon SX engine-based 8-ppm laser printer with scalable fonts and Resolution Enhancement. Accepts HP cartridges and soft fonts. Adobe PostScript option available.

TEXT SPEED: 7.5 ppm
ONE PAGE OUT: 19 sec.
GRAPHICS SPEED: 1.9 gppm
GRAPHICS TIME: 0 min. 32 sec.



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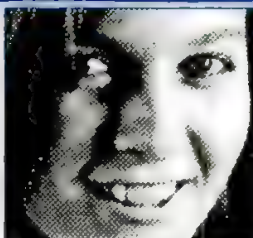


HP LaserJet IIId

\$2,595

Canon RX engine-based 8-ppm duplexing laser printer with scalable fonts and Resolution Enhancement. Accepts HP cartridges and soft fonts. Adobe PostScript option available.

TEXT SPEED: 7.6 ppm
ONE PAGE OUT: 20 sec.
GRAPHICS SPEED: 1.9 gppm
GRAPHICS TIME: 0 min. 32 sec.



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We put 25 font cartridges in one because the perfect printer is just a dream.



Let's face it. There hasn't been a printer built that has all the fonts you need. Which is why we created 25 Cartridges in One!

It has fonts from 25 Hewlett-Packard cartridges, saving you hundreds of dollars. You get 172 fonts and symbol sets such as Prestige Elite, Tms Rmn style and Helv style types. And our 3.6 pt AFS typeface so you can print full Lotus and Excel worksheets. Plus 69 international fonts.

Just plug 25 Cartridges in One! into your LaserJet*. It's compatible with virtually all major word processing software. And even works with our Headlines in a Cartridge product offering 14-48 pt fonts.

25 Cartridges in One! can help make your dream of the perfect printer a reality. To learn more, call or write: Pacific Data Products, 9125 Rehco Rd., San Diego, CA 92121, (619) 552-0880. Fax (619) 552-0889.



PACIFIC
DATA PRODUCTS

*Versions of 25 Cartridges in One! are compatible with HP LaserJet Series II, IIP, IID and III.

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CIRCLE 258 ON READER SERVICE CARD

See us at
COMDEX Booth #W818



THE ONLY EXECUTIVE TOOLS MORE COLORFUL THAN THE GSX-140.

The GSX-140 is the ultimate executive business tool for office and home. It has proven to be the best in its class of 24-wire printers. Especially for a suggested retail of under \$500.00.

Like its wide carriage cousin the new GSX-145, the print quality rivals that of any printer in its class and its six resident fonts give you more flexibility to design your output.

And, like all our new printers, it's equipped with our exclusive Color On Command™ feature which gives you the capability of installing dynamic color to make your spread sheets easier to read, your graphics easier to understand, and your presentations simply brilliant.

Speaking of ease of use, it doesn't take a MIS manager to operate the GSX-140 printer. That's because the Command-Vue™ control panel prompts you with plain English directions on its LCD panel. The "Quick" menu gives you instant access to the printer settings most

often changed. It remembers your four favorite software programs and sets them up just the way you like them, every time you use them.

Blending 192 cps, logic seeking, bidirectional printing and high speed paper feed, the GSX-140's high throughput design quietly cranks out page after page far faster than any of the competition.

What more could a busy executive ask for from a printer? How about peace of mind in the form of a 24-month parts and labor warranty.

Once you've tried the new GSX-140, it'll be easy to see how it makes your reports brighter and life easier. For the dealer near you, just call 1-800-441-2345, ext. 34 in Calif., 1-800-556-2345, ext. 34 outside Calif.

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Citizen logo are trademarks of the Citizen Watch Co. Ltd.

 **CITIZEN**


CIRCLE 318 ON READER SERVICE CARD

IBM LaserPrinter E**\$1,495**

IBM 4019 engine-based 5-ppm HP LaserJet Series II-compatible laser printer. Only accepts proprietary font cards and HP soft fonts. Adobe PostScript option available.

TEXT SPEED: 4.8 ppm
ONE PAGE OUT: 21 sec.
GRAPHICS SPEED: 2.2 gppm
GRAPHICS TIME: 0 min. 27 sec.



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Courier Bold Bold

Kyocera F-1800A**\$4,995**

Kyocera engine-based 18-ppm HP LaserJet Series II-compatible LED printer with scalable fonts. Does not accept HP cartridges. Accepts proprietary font cards and HP soft fonts.

TEXT SPEED: 15.2 ppm
ONE PAGE OUT: 16 sec.
GRAPHICS SPEED: 2.4 gppm
GRAPHICS TIME: 0 min. 25 sec.



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Mannesmann Tally 906PS**\$3,495**

TEC engine-based 6-ppm laser printer with Microsoft/Bauer PostScript emulator and HP LaserJet Series II compatibility. Only accepts proprietary font cards and HP soft fonts.

TEXT SPEED: 5.8 ppm
ONE PAGE OUT: 25 sec.
GRAPHICS SPEED: 0.3 gppm
GRAPHICS TIME: 4 min. 4 sec.



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Relative Bold Underline

Mitek 130T**\$8,995**

Canon SX engine-based 8-ppm Adobe PostScript Tempest laser printer with HP LaserJet Series II compatibility. Does not accept HP cartridges but does accept HP soft fonts.

TEXT SPEED: 7.5 ppm
ONE PAGE OUT: 22 sec.
GRAPHICS SPEED: 0.6 gppm
GRAPHICS TIME: 1 min. 34 sec.



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Line Printer Bold Underline Co

NCR 6436-0501**\$9,450**

Ricoh 4150 white-writing engine-based 15-ppm Adobe PostScript laser printer with HP LaserJet Series II compatibility. Does not accept either HP cartridges or soft fonts.

TEXT SPEED: 3.8 ppm
ONE PAGE OUT: 13 sec.
GRAPHICS SPEED: 0.1 gppm
GRAPHICS TIME: 9 min. 0 sec.



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Relative Bold Underline

NEC Silentwriter2 90**\$2,495**

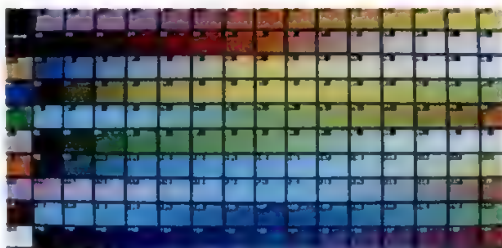
Minolta engine-based 6-ppm Adobe PostScript laser printer with HP LaserJet Series II compatibility. Does not accept HP cartridges but does accept HP soft fonts.

TEXT SPEED: 5.8 ppm
ONE PAGE OUT: 25 sec.
GRAPHICS SPEED: 0.7 gppm
GRAPHICS TIME: 1 min. 24 sec.



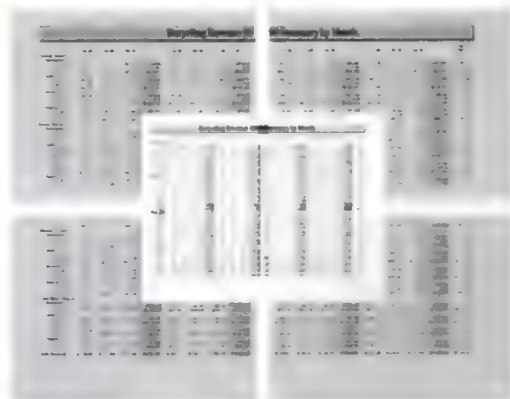
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A palette of 224
dazzling colors—
more than any
other spreadsheet
—to make your
graphics as
powerful as
your words.



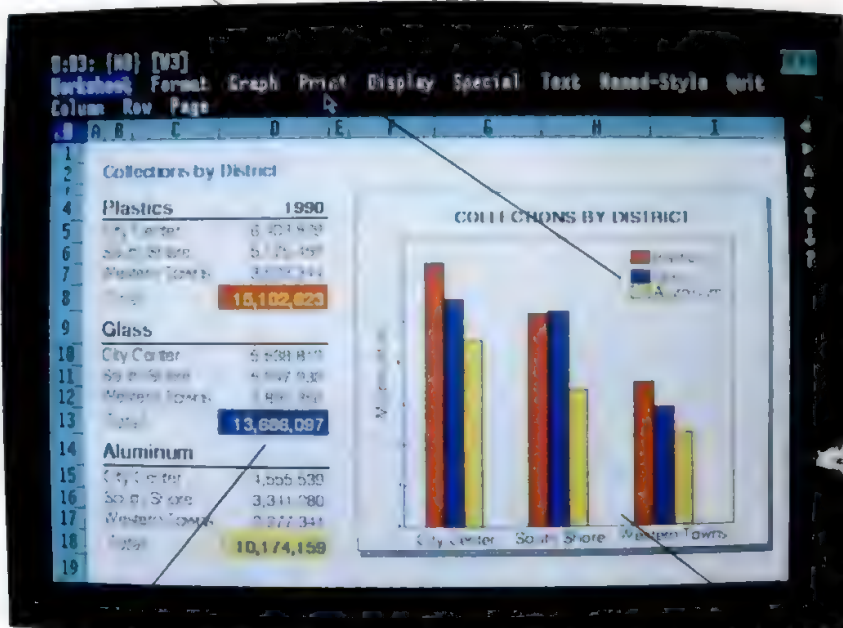
Our Graph Editor lets you add
freehand drawings or symbols to
call attention to critical data.

Q4	1989
1,417,107	6,886,910
1,987,897	5,573,029
1,331,601	3,789,665
5,734,905	16,249,604
3,610,029	12,880,958



Only Release 3.1 offers an auto-compress feature that
quickly reduces larger worksheets so they print on a
single page.

Create drop shadows,
borders and legends.



Use a mouse or the keyboard.
It's up to you.

Combine a variety
of colors, type styles
and formats.

The WYSIWYG world of Release 3.1, with
its Impress technology, means what you
see on screen is exactly what you get
when you print your work.

Display "live" graphs
anywhere on the
spreadsheet.

Think Graphically. Think An

Welcome to the world of Lotus 1-2-3
Release 3.1. Where you'll immediately
discover the ease-of-use of a graphical
environment, complete with mouse sup-
port and full WYSIWYG display. In fact,
Release 3.1 gives you so many creative
options, you'll actually find using it fun.

Of course, you'll also find all the
powerful analytical features that have
made Lotus 1-2-3 the best-selling spread-
sheet in the world. Like our unique 3D
technology and access to external
databases.

But it doesn't end there. Because

Release 3.1 also delivers the most
impressive output imaginable. Along
with the widest range of spreadsheet for-
mating options available. Which means
you have complete control over how you
want your work to look.

And even more importantly, we've

WeCycle Waste Corporation
1990 Recycling Summary

Revenue by Product

Product	Q1	Q2	Q3	Q4	1990
Plastics	1,890,785	1,962,024	2,378,397	2,636,983	9,068,189
Glass	1,700,504	1,862,135	1,869,430	2,600,684	8,032,753
Aluminum	1,146,884	1,182,022	1,488,421	1,801,763	5,420,090
Total	\$4,738,173	\$5,026,180	\$5,737,248	\$7,039,430	\$22,541,092

With Release 3.1 your output looks great in black and white.

Choose from 8 combinations of Bitstream® typefaces which you can scale from 3 to 72 points.

Align titles or text – left, right, even or center – with one simple command.

WeCycle Waste Corporation 1990 Recycling Summary

Last year was a good year for the company. WeCycle was profitable and came very close to achieving our goals in a very uncertain economic and recycling climate.

Revenue by Product

Material collections increased over the year. Plastics continue to bring in the most revenue and profit for the company. Prices for aluminum are still very soft and while we're continuing to collect more glass, markets for the raw material are still in their infancy.

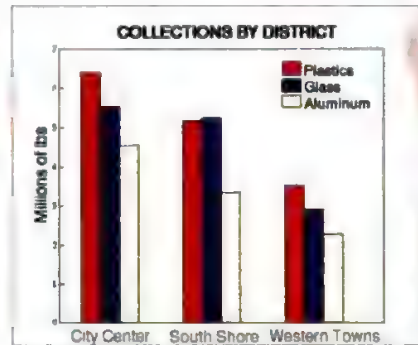
Revenue	Q1	Q2	Q3	Q4	1990
Plastics	1,890,785	1,962,024	2,378,397	2,636,983	9,068,189
Glass	1,700,504	1,862,135	1,869,430	2,600,684	8,032,753
Aluminum	1,146,884	1,182,022	1,488,421	1,801,763	5,420,090
Total	\$4,738,173	\$5,026,180	\$5,737,248	\$7,039,430	\$22,541,092

The graph at the right details our revenue by waste material for the four quarters of 1990. The revenue increases show that communities are building their recycling programs beyond just collecting plastics. Revenue from aluminum and glass have increased as their programs have gained volume. But, we're still seeing price pressure as the supply of recyclable materials continues to exceed the demand. We need to look for ways to expand our markets and increase the use of recycled materials.



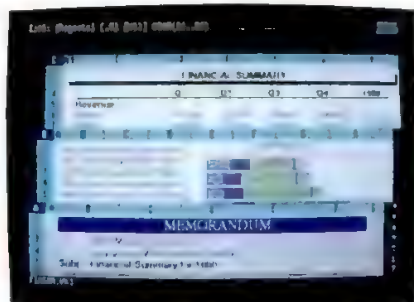
Collections by District

Plastics		1990
City Center	6,403,829	
South Shore	5,175,450	
Western Towns	3,523,344	
Total	15,102,624	
Glass		
City Center	5,536,812	
South Shore	5,247,930	
Western Towns	2,899,356	
Total	13,684,098	
Aluminum		
City Center	4,555,539	
South Shore	3,341,280	
Western Towns	2,277,341	
Total	10,174,160	



Only Release 3.1 automatically wraps text around a graph.

Release 3.1 runs in Windows 3.0. Just click the icon and you're on your way.



Our unique 3D technology. It's the best way to organize your work, link files, consolidate data, or create multi-page reports.

Marbold, italics, underlines, colors and type faces to create over 100 text style combinations – more than any other spreadsheet.

Over 200 graph style combinations that you can size and enhance. You can even display more than one graph per page.

alytically. Think Confidently.

designed Release 3.1 for PCs running either DOS or DOS with Windows™ 3.0.

Plus, when you purchase Release 3.1, you

Lotus 1-2-3 3.1



can count on the best and most comprehensive support in the business. Including six months of 24-hour, 7 days a week, toll-free help.*

So don't think twice. Think Lotus.

Call 1-800-TRADE UP, ext. 976, for upgrade information or for a free Release 3.1 demo disk. And be confident that you're buying the best spreadsheet in the world.

Introducing Lotus 1-2-3

3.1

*24 hour support available in U.S. only

PRINTERS LASERS

NEC Silentwriter 2 290

\$3,995

Canon SX engine-based 8-ppm Adobe PostScript laser printer with HP LaserJet Series II compatibility. Does not accept HP cartridges but does accept HP soft fonts.



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of events in their complete
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is implanted in man's soul.
Courier Bold Underline
Palatino Bold Underline

TEXT SPEED: 7.4 ppm
ONE PAGE OUT: 22 sec.
GRAPHICS SPEED: 0.7 gppm
GRAPHICS TIME: 1 min. 23 sec.

NewGen TurboPS/360

\$4,995

Canon SX engine-based 8-ppm laser printer with RIPS PostScript emulator and HP LaserJet Series II compatibility. Does not accept HP cartridges but does accept HP soft fonts.



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Courier Bold Underline
Palatino Bold Underline

TEXT SPEED: 2.1 ppm
ONE PAGE OUT: 46 sec.
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME: 0 min. 56 sec.

NewGen TurboPS/480

\$7,495

Canon SX engine-based 8-ppm laser printer with RIPS PostScript emulator and HP LaserJet Series II compatibility. Does not accept HP font cartridges but does accept HP soft fonts.



Man's mind cannot grasp the
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Courier Bold Underline
Palatino Bold Underline

TEXT SPEED: 2.1 ppm
ONE PAGE OUT: 47 sec.
GRAPHICS SPEED: 1.0 gppm
GRAPHICS TIME: 1 min. 0 sec.

OkiData OkiLaser 400

\$1,395

Oki Electric engine-based 4-ppm HP LaserJet Series II-compatible LED printer. Only accepts proprietary font cards and HP soft fonts.



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of events in their complete
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Courier Bold Underline
Line Printer Bold Underline

TEXT SPEED: 4.1 ppm
ONE PAGE OUT: 32 sec.
GRAPHICS SPEED: 1.2 gppm
GRAPHICS TIME: 0 min. 50 sec.

OkiData OkiLaser 820

\$2,295

Oki Electric engine-based 8-ppm HP LaserJet Series II-compatible LED printer with scalable fonts. Only accepts proprietary font cards and HP soft fonts.



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TEXT SPEED: 8.1 ppm
ONE PAGE OUT: 15 sec.
GRAPHICS SPEED: 2.5 gppm
GRAPHICS TIME: 0 min. 24 sec.

OkiData OkiLaser 840

\$3,595

Oki Electric engine-based 8-ppm Adobe PostScript LED printer with HP LaserJet Series II compatibility. Does not accept HP cartridges but does accept proprietary font cards and HP soft fonts.



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TEXT SPEED: 7.7 ppm
ONE PAGE OUT: 19 sec.
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 12 sec.

Get the real thing for the price of a reproduction.

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Booth #1842, Las Vegas
Convention Center



True PostScript® printing for only \$2,499*: microLaser™ PS17 from Texas Instruments.

Now you can afford the powerful font and graphics capabilities of the industry-standard PostScript software from Adobe®.

The microLaser PS17 features true Adobe PostScript printing so you don't have to settle for an imitation that costs about the same, but gives you less. Plus, microLaser offers these other advantages:

17 Scalable fonts. Plenty to get you started. If you need more, choose the microLaser PS35 model, with 35 PostScript fonts. Both models feature the new Adobe ATM™ font rendering technology, which improves the quality of PostScript fonts and prints them significantly faster.

The industry standard. With microLaser and PostScript, you can access more than 600 high-quality typefaces and over 4,000 software applications. It's also compatible with the HP LaserJet® Series II and allows you to switch between the HP and PostScript modes easily. Plus, you can connect microLaser to your PC, Macintosh® or virtually any type of computer hardware.



Superior paper handling.

microLaser's paper drawer holds 250 sheets — and it conveniently slides inside the printer to save space. An optional, second 250-sheet paper drawer and envelope feeder are available for extra versatility.

The smallest footprint you'll find.

At only 13.4" wide and 14.2" deep, microLaser offers what BYTE magazine calls, "an exquisitely small footprint and a

compact design, destined for a cramped desktop."***

If you're not ready for PostScript yet, you can buy the standard microLaser for \$1,799*. Then as your needs grow, so do microLaser's capabilities — without tools or technicians. Just add upgrade boards for PostScript software, more memory and optional interfaces. Or plug in microCartridges for additional fonts and emulations.

With all of this capability, why settle for less than the microLaser with PostScript?

Call us for additional information and the name of a dealer near you.

1-800-527-3500.

CIRCLE 304 ON READER SERVICE CARD

**TEXAS
INSTRUMENTS**

PRINTERS LASERS

Olivetti PG 306

\$1,595

TEC engine-based 6-ppm laser printer with Microsoft/Bauer PostScript emulator and HP LaserJet Series II compatibility. Only accepts proprietary font cartridges and HP soft fonts.



TEXT SPEED 6.1 ppm
ONE PAGE OUT 28 sec.
GRAPHICS SPEED 1.8 gppm
GRAPHICS TIME 0 min. 33 sec.

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Line Printer Bold Underline Co

Packard Bell PB9500

\$2,195

TEC engine-based 6-ppm HP LaserJet Series II-compatible laser printer. Accepts both HP-compatible font cartridges and soft fonts.



TEXT SPEED 5.7 ppm
ONE PAGE OUT 25 sec.
GRAPHICS SPEED 1.1 gppm
GRAPHICS TIME 0 min. 55 sec.

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Courier **Bold Under**
Line Printer Bold Underline Co

Panasonic KX-P4420 Laser Partner

\$1,695

Matsushita engine-based 8-ppm LaserJet Series II-compatible laser printer. Does not accept HP cartridges but does accept proprietary font cards and HP soft fonts.



TEXT SPEED 7.4 ppm
ONE PAGE OUT 21 sec.
GRAPHICS SPEED 1.8 gppm
GRAPHICS TIME 0 min. 33 sec.

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Courier **Bold Under**
Line Printer Bold Underline Co

Panasonic KX-P4450 Laser Partner

\$2,095

Matsushita engine-based 11-ppm HP LaserJet Series II-compatible laser printer. Does not accept HP cartridges but does accept proprietary font cards and HP soft fonts.



TEXT SPEED 10.2 ppm
ONE PAGE OUT 19 sec.
GRAPHICS SPEED 1.8 gppm
GRAPHICS TIME 0 min. 33 sec.

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is implanted in man's soul. -T
Courier **Bold Under**
Line Printer Bold Underline Co

Printware 720 IQ Professional II

\$11,990

Printware engine-based 8-ppm laser printer with Printstyle PostScript emulator. Capable of 1,200- by 600-dpi output. Does not accept either HP font cartridges or soft fonts.



TEXT SPEED 7.5 ppm
ONE PAGE OUT 26 sec.
GRAPHICS SPEED 0.6 gppm
GRAPHICS TIME 1 min. 35 sec.

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is implanted in man's soul.
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Palatine Bold Underline

QMS PS-410

\$2,795

Canon LX engine-based 4-ppm Adobe PostScript laser printer with HP LaserJet Series II compatibility. Does not accept HP cartridges but does accept HP soft fonts.



TEXT SPEED 3.6 ppm
ONE PAGE OUT 37 sec.
GRAPHICS SPEED 0.4 gppm
GRAPHICS TIME 2 min. 45 sec.

Man's mind cannot grasp the
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is implanted in man's soul.
Courier **Bold Under**
Palatine Bold Underline



Sometimes it's just not practical to run a cable from a computer to a printer.

For those times, there's this.

Meet a genuine breakthrough: the Verran AC DataLink. It lets you connect virtually any computer to a printer. Or a modem. Or a plotter. Or a terminal. All *without cables*. The connection takes place through your building's electrical wiring and works at distances of 300 feet or more.

Think of it. No more torn-up offices, expensive wiring solutions, or cabling headaches. The Verran AC DataLink is the perfect answer for quick connections between computers and peripherals—even if they're in different offices.

The applications are numerous—from office moves to demonstrations to special needs for temporary staff. You can even connect extra terminals to a larger computer without cabling—a feature which can be invaluable when additional programmers come on board.

There's no software required. A pair of AC DataLinks is all you need. Just connect one to your computer and one to a peripheral. Then plug each into a standard electrical outlet. That's it. You're up and running in minutes.



The AC DataLinks take care of everything: error correction, translation when needed, even adaptors for parallel (Centronics) or serial (RS-232) connections. So you can enjoy virtually universal compatibility between computers and peripherals—even use a parallel printer from a serial port! You can also select an encryption code for each pair of AC DataLinks, providing a high level of data security.

And here's another breakthrough from Verran: the AC DataLink DPS (Dedicated Printer Sharer) which allows up to seven computers connected to AC DataLinks to share the same printer. It's like having a printer for each computer—at a fraction of the cost.

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AC DataLink DPS just \$395.
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703-648-1551

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Filler, so you can lock the design of your forms and spread Filler around a bunch of IBM PCs or compatibles.

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2.1 Rebate
\$30⁰⁰

DELRIINA
TECHNOLOGY INC.



QMS PS-810 Turbo

\$5,495

Canon SX engine-based 8-ppm Adobe PostScript laser printer with HP LaserJet Series II compatibility. Does not accept HP cartridges but does accept HP soft fonts.

TEXT SPEED: 7.5 ppm
ONE PAGE OUT: 22 sec.
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 12 sec.



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QMS PS-820 Turbo

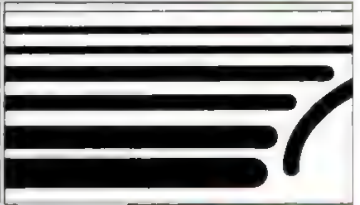
\$6,495

Canon TX engine-based 8-ppm Adobe PostScript dual-bin laser printer with HP LaserJet Series II compatibility. Does not accept HP cartridges but does accept HP soft fonts.

TEXT SPEED: 7.5 ppm
ONE PAGE OUT: 22 sec.
GRAPHICS SPEED: 0.7 gppm
GRAPHICS TIME: 1 min. 23 sec.



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QMS PS-2210

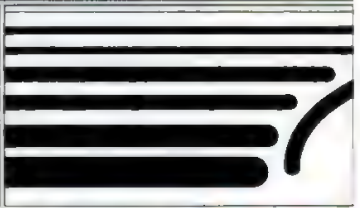
\$11,995

QMS/Matsushita engine-based 22-ppm Adobe PostScript laser printer with HP LaserJet Series II compatibility. Does not accept HP cartridges but does accept HP soft fonts.

TEXT SPEED: 17.3 ppm
ONE PAGE OUT: 16 sec.
GRAPHICS SPEED: 1.0 gppm
GRAPHICS TIME: 1 min. 0 sec.



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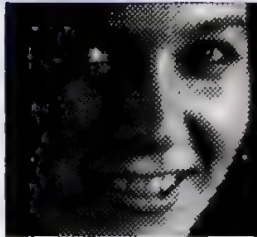


Qume CrystalPrint Express

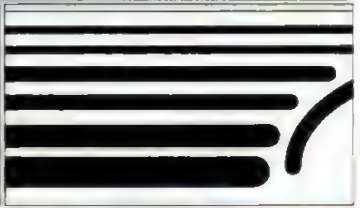
\$5,595

Sanyo engine-based 12-ppm laser printer with RIPS/Qume PostScript emulator and HP LaserJet Series II compatibility. Does not accept HP cartridges. Accepts HP soft fonts.

TEXT SPEED: 2.6 ppm
ONE PAGE OUT: 45 sec.
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 19 sec.



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Relative Bold Underline



Qume CrystalPrint Publisher II

\$3,995

Casio engine-based 6-ppm LCS printer with RIPS/Qume PostScript emulator and HP LaserJet Series II compatibility and mode switching. Only accepts proprietary font cards and HP soft fonts.

TEXT SPEED: 5.2 ppm
ONE PAGE OUT: 31 sec.
GRAPHICS SPEED: 0.5 gppm
GRAPHICS TIME: 1 min. 53 sec.



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Relative Bold Underline



Qume CrystalPrint Series II

\$1,499

Casio engine-based 6-ppm HP LaserJet Series II-compatible LCS printer. Does not accept HP-compatible font cartridges but does accept proprietary font cards and HP soft fonts.

TEXT SPEED: 5.8 ppm
ONE PAGE OUT: 23 sec.
GRAPHICS SPEED: 1.7 gppm
GRAPHICS TIME: 0 min. 35 sec.



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If you think the HP LaserJet III is great,

ASTRONOMY IS LOOKING UP

THE WEEKLY REPORT OF THE SKIES
VOL. 6 NO. 4 FALL 1989

STAR SHOTS

Reported by The Star

Every day billions of dust particles enter Earth's atmosphere. How accurately are we able to track them?

The Sun's Size the Great Wall from the Moon?

Everyone has heard that you can see the Great Wall of China from the Moon. Or from Earth orbit. Or even from Mars. Certainly you cannot see the Great Wall from the Moon. According to

best-bet communication a practical and economical alternative to the use of balloons on page 30

an astronomer, it's difficult even to see familiar objects; the planet's orbit is too small on page 30



More on planetary implications inside

NO BLACK HOLES?

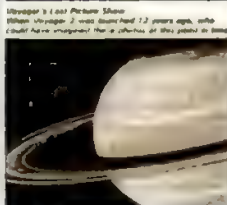
Scientists are still unable to explain the existence of even a single black hole, despite widespread belief that such things should exist. Trailing down these invisible objects isn't easy because they can only be studied indirectly by the effects they have on their surroundings. There are several types of places that

continued on page 30

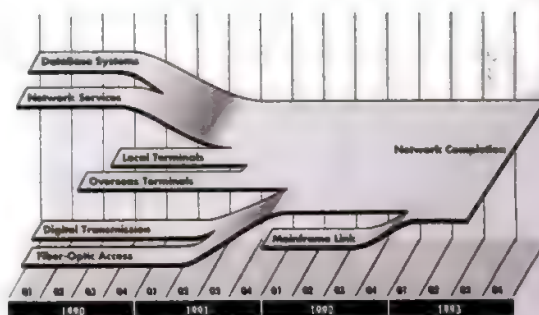
MIRROR, MIRROR

It's a show, but all reflecting telescopes require clearing their reflective mirrors. Eventually, the aluminum coating on their mirrors deteriorates and needs replacing. For large instruments, the process requires removing the mirror

continued on page 30

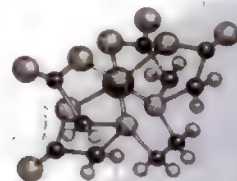


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CHAIN REACTION

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How Long to Reach

Optimal Conditions

What's New in

Superconductivity?

Antimatter Busted

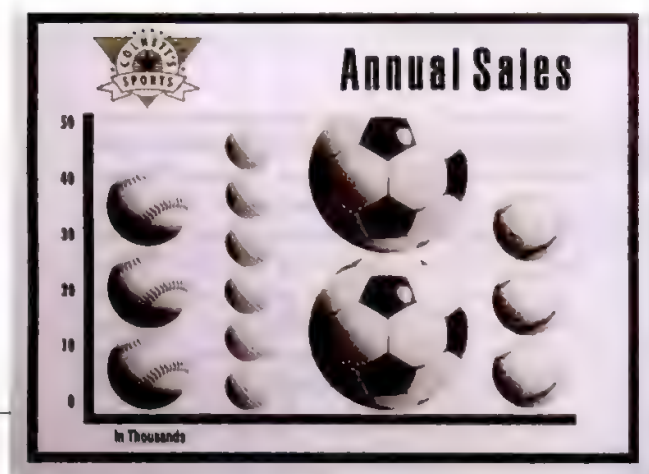
Fifty Years Ago

Many organic chemists bridge the gap between organic and inorganic chemistry. It can lead to important new products for a variety of uses in chemical, medical, and other fields. For example, hydrogels, hydrogels and hydrogels. See our special issue of articles and reviews from our special issue.

It was about twenty three years ago that a constant material that superconducts above liquid nitrogen temperature was discovered. It was the first of the discovery of superconductors, and temperature was then being studied in a variety of materials. Yet superconductivity was not a new phenomenon. The effect was first observed in mercury in 1911, and, since then, more than 3000 elements, alloys, and compounds have been found to superconduct.

A device named after the physicist's glimpse of what we call the world's most basic law. The device can be used to measure a few degrees above absolute zero and store it for several days at a time.

Butter has it that before WWII, our chemists were experimenting with a long process to lower the volume of ordinary base. Adapting the research to the needs of world war, researchers then pursued the development of a short stable 'rotam'. Don't believe all rumors.

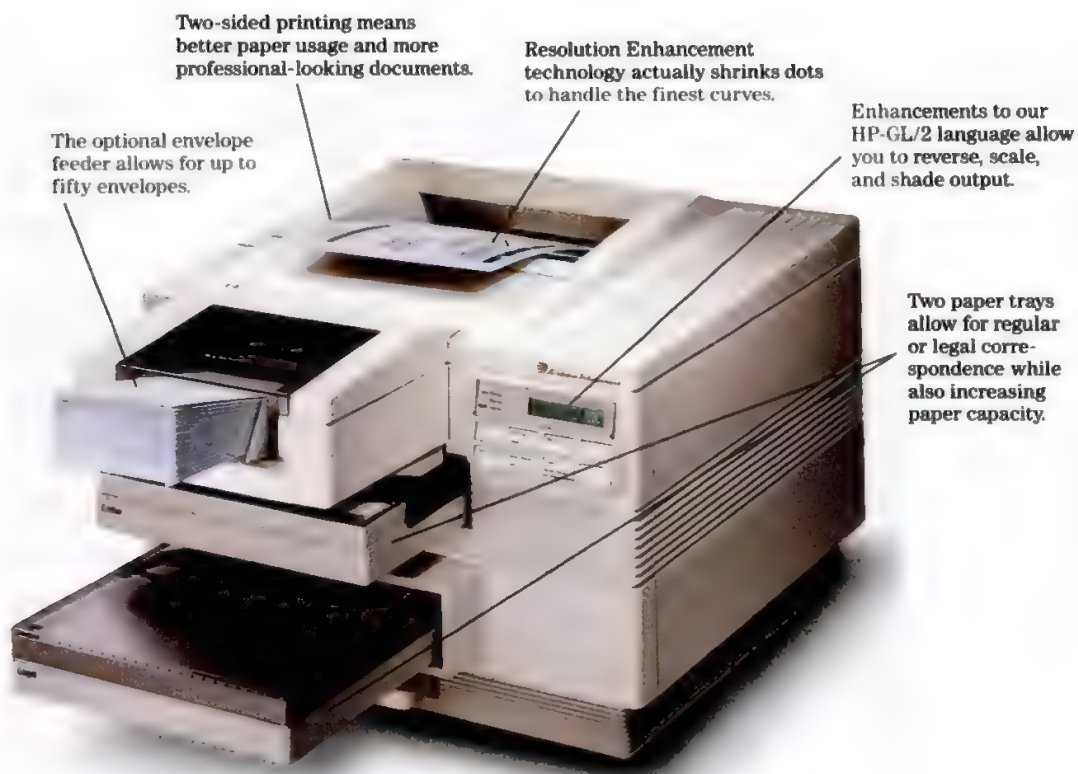


Introducing the new HP LaserJet IIID printer. The LaserJet that combines all of the advanced capabilities of the exciting LaserJet III with all of the paper-handling features required by today's busy office. There's a lot to like. Like two paper trays for different types and sizes of paper. 200-sheet

capacity in each of those trays for less reloading. And two-sided printing that lets you easily condense your output. Even an optional automatic envelope feeder that eliminates manual feeding. Equally impressive is HP's Resolution Enhancement technology.

Pioneered in the LaserJet III, this technology actually varies the sizes of dots. So curves really curve. Lines are never jagged. And you get resolution never before seen in a 300 dpi printer. Output has never looked so good. Documents can be made even more elaborate thanks to our en-

you'll automatically like the new HP LaserJet IID.



hanced PCL5 printer language, which includes HP-GL/2 graphics language. You can print regular or reverse type. Shaded text. Even portrait and landscape on the same page.

Beyond this, all types of options are available for all types of users. Which means you can customize with Adobe® PostScript® software. Add memory. Or better express yourself with our MasterType

library of fonts and typefaces. You can even connect a Macintosh.

The best part is that the \$2,395* LaserJet III and \$3,595* LaserJet IID are both easily within any budget. So call 1-800-752-0900, Ext. 1586. We'll tell you where to find your nearest authorized HP dealer.



**HEWLETT
PACKARD**

Qume CrystalPrint Super Series II

\$1,999

Casio engine-based 6-ppm HP LaserJet Series II-compatible LCS printer. Does not accept HP-compatible font cartridges but does accept proprietary font cards and HP soft fonts.

TEXT SPEED: 6.0 ppm
ONE PAGE OUT: 23 sec.
GRAPHICS SPEED: 1.6 gppm
GRAPHICS TIME: 0 min. 37 sec.



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Star LaserPrinter 8II

\$3,049

Canon SX engine-based 8-ppm laser printer with LincPage PostScript emulator and HP LaserJet Series II compatibility. Only accepts proprietary font cartridges and HP soft fonts.

TEXT SPEED: 7.5 ppm
ONE PAGE OUT: 21 sec.
GRAPHICS SPEED: 0.1 gppm
GRAPHICS TIME: 5 min. 38 sec.



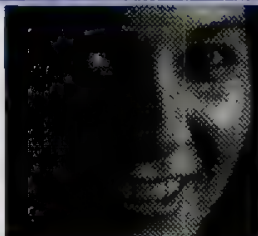
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Texas Instruments microLaser

\$2,999

Sharp engine-based 6-ppm Adobe PostScript laser printer with HP LaserJet Series II compatibility. Only accepts proprietary font cartridges and HP soft fonts.

TEXT SPEED: 6.3 ppm
ONE PAGE OUT: 23 sec.
GRAPHICS SPEED: 0.6 gppm
GRAPHICS TIME: 1 min. 41 sec.



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Toshiba PageLaser6

\$1,549

TEC engine-based 6-ppm HP LaserJet Series II-compatible laser printer. Accepts both HP-compatible font cartridges and soft fonts.

TEXT SPEED: 5.6 ppm
ONE PAGE OUT: 25 sec.
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME: 0 min. 55 sec.



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Apple Personal LaserWriter NT

by Bill O'Brien

Despite persistent rumors to the contrary, Apple hasn't abandoned PostScript. In fact, this year there is a new pony in Apple's printer stable, the Personal LaserWriter. Based on Canon's LBP-LX 4-ppm engine, this new member of the LaserWriter family, though PostScript-compatible, doesn't have the page-scorching speed for which its older sibling, the NTX, is famous. And, its \$3,299 price is nearly double what PC users typically pay for 4-ppm devices.

There are two versions of the Personal LaserWriter. The SC is an Apple Quick-

Draw-compatible unit with a relatively modest list price of \$1,999. With estimated street prices between \$1,600 and \$1,800, this is the product that will put a laser printer on the desk of every serious Macintosh user. The NT version can be had as either a \$1,300 controller-board upgrade to the SC, or as a complete unit, including PostScript, an HP LaserJet Plus emulation, and 2MB of RAM.

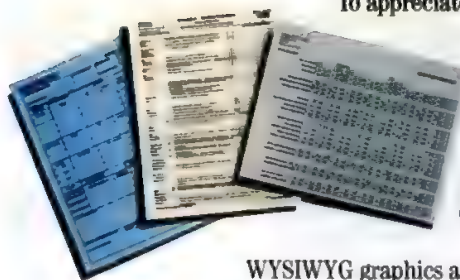
Surprisingly, there is no discount for purchasing a complete NT package right off. The cost of the SC and the upgrade controller board equals the cost of the NT. It's a strange marketing move, considering that NT includes serial and AppleTalk interfaces—making it equally usable by Macintosh or PC owners.

Aside from the 2MB of RAM (which is

barely adequate for a PostScript printer), the Personal LaserWriter comes with all the initial consumables. The combination toner and photoconductor cartridge will set you back only \$90 when it needs to be replaced. To its credit, Apple also included a 250-sheet paper cassette, forgoing the hardly adequate 50-sheet tray found on both the Canon LBP-4 and the HP LaserJet IIP—a \$195 savings. A cassette for legal-sized paper will set you back \$79 and an envelope cassette costs \$89.

Choosing among the three emulations—PostScript, HP, and AppleTalk—isn't too difficult, but Apple has done little to make it easier. Selection is accomplished by a thumbwheel switch that displays any of nine numbers: zero through eight. Each digit represents an emulation

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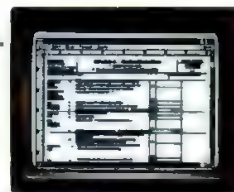
And connects more effectively to networks. So both forms and the information they contain can be better shared and communicated - across departments, or entire organizations. And not just with IBM® PCs, but with HP®3000s, HP9000s, DEC® VAXs™ and UNIX® machines.



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Will it handle all your forms needs? Including complex policies and contracts, as well as bar code labels? Will it handle them in the volume you'll need as your forms applications grow?

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Just because it "links" to your database doesn't mean it takes full advantage of database links. JetForm verifies data, performs calculations, and fully reads and writes dBASE files.

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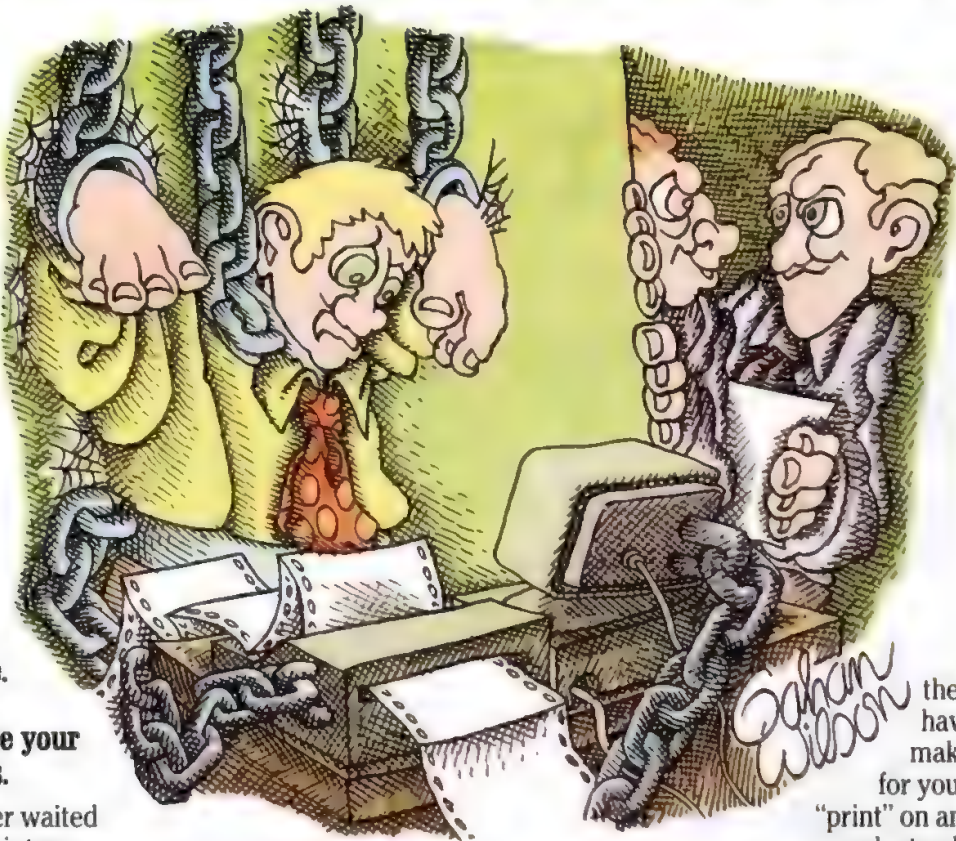


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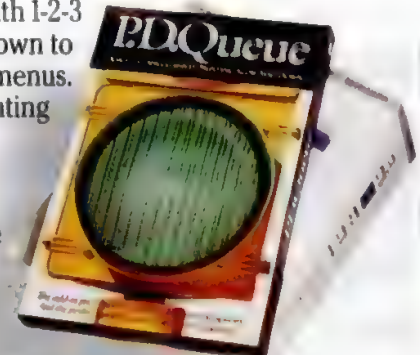
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PRINTERS

LASERS

Fonts & Features

Apple Personal LaserWriter NT

PostScript			
Helvetica	Times	Courier	Line Printer
Underline	Underline	Underline	Underline
Sub-Super	Sub-Super	Sub-Super	Sub-Super
Italic	Italic	Italic	Italic
Bold	Bold	Bold	Bold
8.9-point			
10-point			
12-point			
14-point			
Scalable			

HP LaserJet Plus			
Helvetica	Times	Courier	Line Printer
Underline	Underline	Underline	Underline
Sub-Super	Sub-Super	Sub-Super	Sub-Super
Italic	Italic	Italic	Italic
Bold	Bold	Bold	Bold
8.9-point			
10-point			
12-point			
14-point			
Scalable			

mode and the I/O port with which it can be used. However, a decal is sorely needed on the printer's side to distinguish one from the other.

AppleTalk has its own circular DIN connector for Macintosh compatibility, but PC owners are left to the relatively slow serial port for their communication with PostScript or PCL. Although PostScript is a bidirectional printer control

language, even at 9,600 bps, a bitmapped image like that contained in PC Labs' graphics speed test takes almost intolerably long to cross the wires one bit at a time.

The true reflection of its dearth of speed in this test is a timed result of 0.07 graphic pages per minute. Compare that with its 0.4 gppm rating (nearly six times faster!) under PCL and the LaserWriter NT becomes more attractive as a graphics engine under the Hewlett-Packard emulation. At 3.9 ppm for the text speed test under either emulation, character printing doesn't suffer from serial communications and seems best under the rich scalable-font assortment available from PostScript.

Your buying decision, however, will be directed by the competition. Other 4-ppm printers all fall in the under \$1,600 category (with street prices of less than \$1,000), making the \$3,299 LaserWriter NT's tag too steep for most. And even if you need PostScript, you should know that Okidata's Okilaser 840, for example, has a competitive \$3,599 price. More important, that extra \$300 will buy you an 8-ppm printer with the same emulations and equitable features. This looks like one Apple printer not destined for the PC bunch.

Brother HL-4

by Alfred Poor

In the past, Brother has marketed printers that successfully compete against the high standards set by the HP LaserJet family; it's done this by adding value without adding cost.

The \$1,495 HL-4 has much in common with Hewlett-Packard's LaserJet IIP, starting with the use of Canon's diminutive LX print engine. This engine offers its toner and drum in a single, convenient cartridge; it also sports flexible paper handling and a rugged, reliable design. The toner and drum cartridge is rated for 3,500 pages compared with 4,000 for Canon's SX cartridges. Brother charges \$95 for these, which works out to a respectable cost of 2.7 cents per page (not including paper).

One obvious area where the HL-4 goes beyond the LaserJet IIP is in the area of fonts. The IIP comes with Courier and Line Printer fonts, but you need to add a

Fonts & Features

Brother HL-4

HP LaserJet Series II			
Helvetica	Times	Courier	Line Printer
Underline	Underline	Underline	Underline
Sub-Super	Sub-Super	Sub-Super	Sub-Super
Italic	Italic	Italic	Italic
Bold	Bold	Bold	Bold
8.9-point			
10-point			
12-point			
14-point			
Scalable			

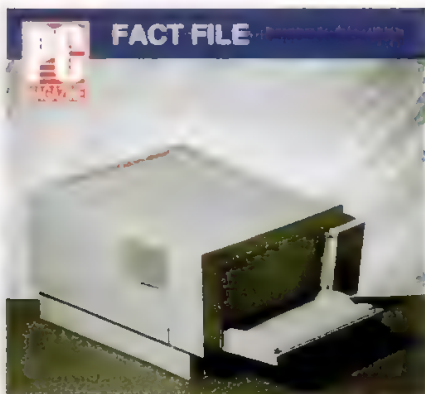
IBM Proprinter			
Bold	Italic	Sub-Super	Underline
10 cpi			
12 cpi			
Compressed			
Proportional			

cartridge or use downloaded fonts if you want more. The HL-4 comes with four different typefaces built right into the printer: 10- and 12-pitch Courier, Times, Helvetica, and Letter Gothic.

There are problems with these fonts, however. First, the Times and Helvetica are named "BR-01T" and "BR-02H." Not only are the names about as memorable as losing vice presidential candidates, they're also a potential source of confusion. The section of the manual on selecting fonts in HP mode mentions only the Times and Helvetica names, but the sample font page only mentions the Brother names. You might have a hard time figuring out what escape sequences to send to get the font you want.

There are other problems with fonts. The Courier is called "Brougham," which is more confusing than serious. There is no Line Printer font, but instead Brother includes a 16.66-pitch Letter Gothic. While Brother's choice is more attractive than the ugly HP Line Printer font, the digit "1" and the lowercase "L" in the Brother font look too much alike. Since most people rely on this font for printing large spreadsheets, the difference between these two characters is important and the HL-4 fails to make the difference clear enough. Also, the Times and Helvetica fonts only come in a 10-point size, which is a little small for most applications—12-point is more readable and might have been a better choice.

On the other hand, there are many things to like about the way the HL-4 handles fonts. It can automatically rotate any font so it can print in either portrait or landscape. The controller can produce bold, italic, and bold italic versions of the



Apple Personal LaserWriter NT

Apple Computer Inc., 20525 Mariani Ave., Cupertino, CA 95014; (408) 996-1010.

List Price: \$3,299; optional envelope cassette, \$89; optional legal cassette, \$79; optional letter cassette \$79.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 9.8 x 15 x 18.3 in.

Weight: 32 lbs.

Emulations: PostScript, HP LaserJet Plus, Diablo 360.

In Short: The Personal LaserWriter NT is flawless, but Apple's pricing—even with HP LaserJet Series II emulation included—is dangerously close to printers with twice the speed. Look at this one only if the real McCoy means more to you than a bargain.

CIRCLE 399 ON READER SERVICE CARD



Brother HL-4

Brother International Corp., 200 Cottontail Lane, Somerset, NJ 08875; (201) 981-0300. **List Price:** \$1,495; upgrade to 1.5MB RAM, \$495; upgrade to 2.5MB, \$990; upgrade to 4.5MB, \$1,980; emulation card, \$295; font cards, \$195 each; optional second paper bin, \$195.

Standard Warranty: One year on parts and labor; depot service.

Dimensions (HWD): 8.8 x 28.3 x 13.5 in.

Weight: 26.5 lbs.

Emulations: HP LaserJet Series II, IBM Proprinter, Epson FX, Diablo 630, Brother Twinwriter.

In Short: The Brother HL-4 adds features beyond those offered by the HP LaserJet IIP, which it emulates. But those features are of limited value and you can't use many of the third-party expansion products available for the IIP. If you need what the HL-4 offers without any expansion, it's a good value; otherwise you can do better elsewhere.

CIRCLE 400 ON READER SERVICE CARD

fonts on the fly, which effectively increases the number of fonts included by a multiple of four. You can add two other sets of fonts through font cards that retail for \$195.

In addition to HP LaserJet IIP emulation, the printer offers IBM Proprinter, Epson FX, Diablo 630, and Brother Twinwriter emulations. You can add HPGL (the graphics language used in HP pen plotters) for \$295. Other available options include a \$195 250-sheet paper tray to augment the 50-sheet bin, and memory upgrades that add 1MB to 4MB to the standard 512K. Prices range from \$495 for 1MB to \$1,980 for 4MB.

In the final analysis, the value added to the Brother HL-4 may be of limited appeal. If you were to add all these features to a LaserJet IIP, it would certainly cost much more than the HL-4, making the Brother printer more attractive. On the other hand, if you want to make use of the many add-on products that are available for the HP printer from a variety of sources, you won't be able to use them on the Brother. It comes down to this: If the HL-4 meets your needs as it stands, then it may be your bargain. But if you intend to add

PRINTERS LASERS

onto it in the future, you might do better if you look elsewhere.

Canon LBP-4

by Bill O'Brien

It's very easy to draw comparisons between Canon's 4-ppm LBP-4 and Hewlett-Packard's LaserJet IIP. They both use the same Canon LBP-LX laser engine and Canon's \$1,545 price tag is quite close to HP's suggested list price of \$1,495 for the IIP. Even the LBP-4's 8-by 13.5-by 26.8-inch case size is identical to the IIP's. And even though one of the major points at which they diverge is that the LBP-4 doesn't provide a PCL emulation—an industry standard—such a possibly negative comparison can be misleading.

The LBP-LX engine requires a combination toner and drum cartridge retailing for \$95, which will last through 3,500 copies of text. Font cartridges cover both fixed and scalable families and list for \$195 to \$295. There is even an IBM Proprinter emulation cartridge for \$245. Canon's near-300-page user's manual contains all the installation and operational instructions you're ever likely to need.

Further, the LaserJet IIP offers only Courier, Courier Bold, and Line Printer fonts—a rather thin selection compared with the assortment of bitmapped and scalable fonts found in the LBP-4. Canon's

littles laser includes the Courier family in plain, bold, and italic in fixed 12- and 8.16-point sizes. The smaller Line Printer-like size even comes in two different pitches, 15 and 16.66. And, except for the 15-pitch font, IBM's high order characters are supported throughout.

Included as well are the scalable Times Roman and Helvetica look-alikes, Dutch-Roman and Swiss, in normal, bold, and italic modes. In last year's model, to access these fonts you needed to enter a nearly endless stream of control characters whenever you wanted to choose among them. And because a driver was available only for *Microsoft Windows* or *Word*—which couldn't take full advantage of the scalable fonts in the current models—LBP-4 owners had a legitimate gripe. This year, Canon has included drivers for 14 different software packages. The group includes *Windows*, *GEM*, *WordStar*, *MultiMate*, *WordPerfect*, and *Lotus 1-2-3*.

The LBP-4 is no performance slouch. At 3.9 ppm it conquered PC Labs' text speed test in good form for its 4-ppm engine. Even the graphics numbers bear close attention; the LBP-4 finished the graphics speed test in just under 1

FONTS & FEATURES				
Canon LBP-4				
Canon CaPSL				
	Helvetica	Times	Courier	Line Printer
	Underline	Underline	Underline	Underline
	Sub-Super	Sub-Super	Sub-Super	Sub-Super
	Italic	Italic	Italic	Italic
	Bold	Bold	Bold	Bold
8/9-point				
10-point				
12-point				
14-point				
Scalable				
Diablo 630				
	Helvetica	Times	Courier	Line Printer
	Underline	Underline	Underline	Underline
	Sub-Super	Sub-Super	Sub-Super	Sub-Super
	Italic	Italic	Italic	Italic
	Bold	Bold	Bold	Bold
8/9-point				
10-point				
12-point				
14-point				
Scalable				



Canon LBP-4

Canon USA Inc., One Canon Plaza, Lake Success, NY 11042; (800) 848-4123, (516) 488-6700.

List Price: \$1,545; upgrade to 1.5MB RAM, \$2,040; emulation cards, \$195 to \$245; font cards, \$195 to \$295; letter cassette adapter and tray, \$195.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 8 x 15.9 x 28.3 in.

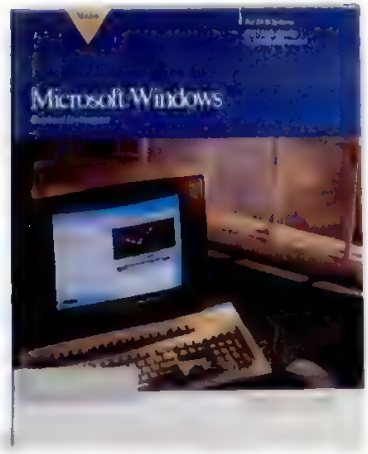
Weight: 23 lbs.

Emulations: Diablo 630, Canon CaPSL.

In Short: The LBP-4's lack of LaserJet compatibility is less of a problem now that software drivers are available from Canon and major software vendors. Internal bitmapped as well as scalable fonts make it a personal printer worth a second look.

CIRCLE 401 ON READER SERVICE CARD

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With ATM software, you get more than you pay for. Including software for these 13 popular fonts, which cost hundreds of dollars if purchased separately. But there are more ways to save—check out the Adobe® Plus Pack for \$198.* Along with ATM, it completes the full set of 35 fonts found in most PostScript printers. Or try Adobe Type Set™ 1, 2 or 3—each with 7 to 11 fonts for just \$99-\$198.*

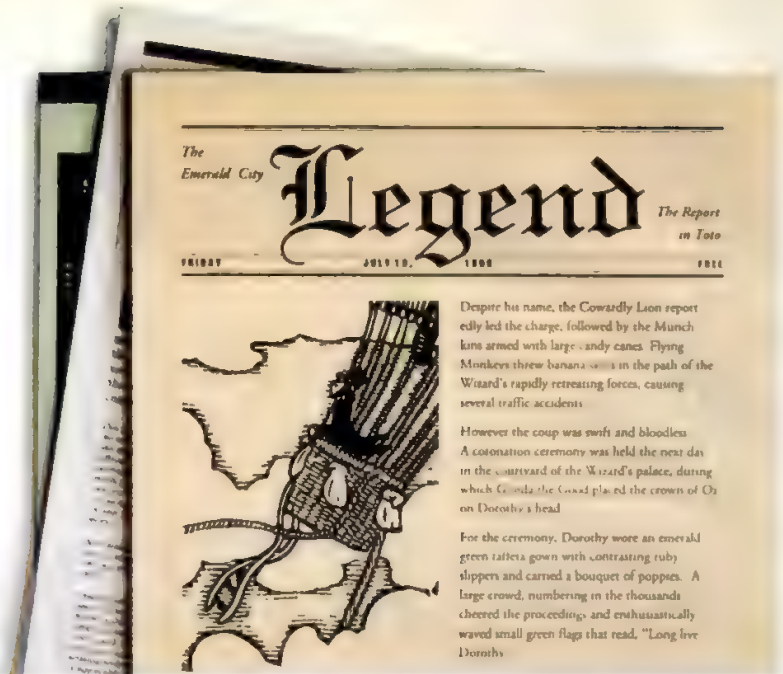
Included with ATM:

**Times™ Roman, *Italic*,
Bold, *Bold Italic***

**Helvetica™, *Oblique*,
Bold & *Bold Oblique***

**Courier, *Oblique*,
Bold, *Bold Oblique***

Symbol ΩΨΦ&®™♣♠♣



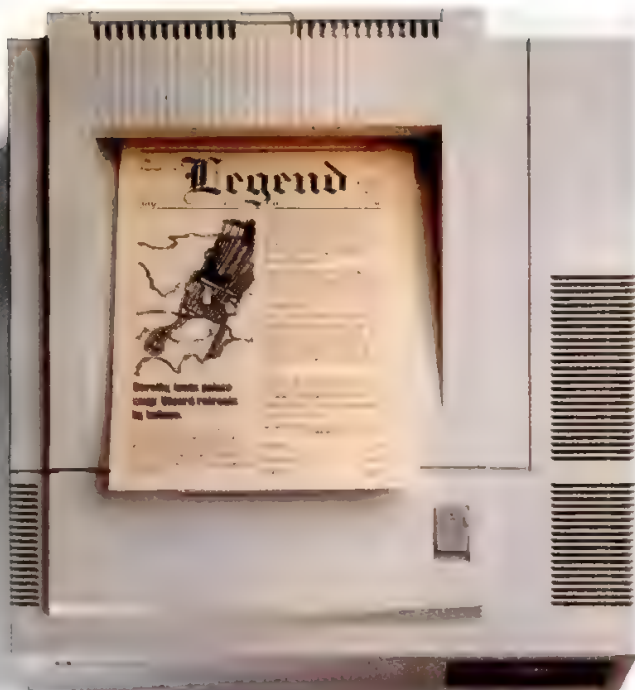
One of the beauties of ATM software is that it automatically scales type to most any size, from headlines to text.

Talk about choice—ATM works with the thousands of PostScript® language Type 1 fonts currently available, including the more than 650 typefaces in the Adobe Type Library. So not only can you choose any look you like, but you'll look great once you've done it.

ATM software cleans up the jaggies and brings you closer to true WYSIWYG, because you're using the same outline fonts on screen as in your printer. All of which makes it easy to see how ATM makes Windows 3.0 look good.



Now your HP LaserJet™ can use the same high-quality fonts only PostScript printers could use before. Plus, your dot matrix or other non-PostScript printer will give you near-laser quality output using the same PostScript language fonts. And since ATM software works with your existing printer drivers, there's no need to modify files.



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Adobe Type Manager® software is the amazing new program that does everything you see here. And does it with virtually any Windows 3.0 application.

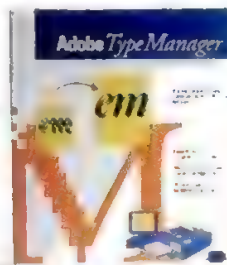
For starters, ATM® software dramatically improves the quality of all your on-screen text. But that's just half the story. Because it also gives you near-laser quality type from your dot matrix or other non-PostScript® printer. And if you're fond of fonts, you should know ATM even allows you to use literally thousands of typefaces in just about any size imaginable.

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EDITOR'S CHOICE

- HP LaserJet III
- HP LaserJet IIID
- IBM LaserPrinter E
- NEC Silentwriter2 90
- QMS PS-2210

Of the 47 laser printers reviewed in this year's special issue on printers, five merit *PC Magazine's* Editor's Choice: the standard-setting, 8-ppm \$2,395 HP LaserJet III and its duplex-printing sibling, the \$3,595 HP LaserJet IIID; IBM's affordable, \$1,495, 5-ppm LaserPrinter E; NEC's \$2,495, 6-ppm, PostScript/PCL Silentwriter2 90; and QMS's \$11,995, 22-ppm, PostScript/PCL PS-2210.

This is the year of the scalable font printer. Of the laser printers reviewed, 20 use Adobe PostScript (or PostScript-compatible routines), and many others can be readily upgraded to PostScript. Our five Editor's Choice printers reflect these trends: The two HPs have scalable fonts built-in and can be upgraded to PostScript, the IBM has a PostScript option, and the NEC provides both PostScript and HP LaserJet Series II compatibility, as does the QMS. The PostScript winners all use genuine Adobe-brand PostScript, although we expect PostScript-compatibles will match Adobe in the near future, particularly Microsoft/Bauer and *PhoenixPage*.

If there's one printer with which you can't go wrong, it's the HP LaserJet III. Hewlett-Packard built on the best-selling 8-ppm Canon SX engine in the LaserJet Series II and added the latest version of its printer command language, PCL 5, as well as Resolution Enhancement. With Intellifont, PCL 5 provides scalable, rotatable fonts. PCL 5 also includes Hewlett-Packard's Graphics Language for ultra-fast graphics. Resolution Enhancement, a proprietary method of adjusting dot size, provides smoother text and graphics: The result is print quality that merits nothing less than "Best in Show."

The LaserJet III turned in 7.5 ppm on PC Labs' text speed test and 1.9 gppm on our graphics speed test—typical scores for the SX engine. (Expect to see graphics printing speed climb as software learns to combine HPGL/2 and PCL 5 in one pass.) And HP's aggressive pricing effectively determines whether every other printer on the market has been properly priced. For the LaserJet III, expect to see one-third discounts off the \$2,395 list price for a street price around \$1,600—about the same as the LaserJet Series II, which listed for \$2,695. (Street price remains similar because HP cut back some of the dealer margins.)

Although PCL 5's scalable font technology gives you many of the benefits of PostScript printers, we also recommend the HP LaserJet III as a PostScript printer, configured with HP's \$695 Adobe PostScript cartridge for 7.4-ppm text speed. If you need duplex (both sides) printing or dual bins, choose the similar LaserJet IIID for an additional \$1,200.

If we have any quibbles with the LaserJet III, it's that the unit hasn't been downsized as much as some competitors, and that the front panel could be easier to use—a complaint we'd level at virtually every printer we've ever seen.

PERSONAL PAGE PRINTERS

Last year, Hewlett-Packard ushered in the era of the personal laser printer—compact footprint, 4- to 6-ppm engine speed, and a street price under \$1,000—with the \$1,495 HP LaserJet IIP. This year, the best personal laser printer is IBM's LaserPrinter E, a 5-ppm unit that also lists for \$1,495 and sells for under \$1,000. At 2.2 gppm, graphics speed is outstanding—and faster than the 1.6 gppm achieved last year by the LaserPrinter E's 10-ppm sibling. IBM provides a 200-sheet paper tray

while the HP IIP and other printers based on the 4-ppm Canon LX engine provide a 50-sheet tray that virtually forces you to spend an extra \$195 for the 200-sheet tray.

As with the IIP, which we continue to recommend, you can upgrade the LaserPrinter E to run PostScript. The IBM Adobe PostScript upgrade adds \$499 to the cost and provides an extra page per minute of text speed. (You'll also need a \$449 1MB memory upgrade.) If you're so inclined, you can even upgrade to the 10-ppm IBM Laser Printer, an Editor's Choice last year, for \$1,099.

For \$2,495, just \$100 more than the LaserJet III, you can have both PostScript and PCL in the NEC Silentwriter2 90. Based on a 6-ppm Minolta engine, NEC provides the best combination of performance and value among mid-range PostScript printers, providing text speed at 5.8 and 5.5 ppm in HP and PostScript modes, respectively. Print quality is excellent. Don't confuse the Silentwriter2 90 with the 8-ppm NEC Silentwriter2 290, which includes PostScript and PCL. At \$3,995, it's a fine performer but not as price competitive.

Once you've got the QMS PS-2210 in your office, you'll be amazed by how often you find uses for its B-size (11- by 17-inch) output. It's a rugged workhorse, as well it should be for \$11,995. Many other vendors have tried B-size print engines and given up over technical and quality problems; QMS deserves credit for making B-size lasers work.

HONORABLE MENTIONS

Nine other printers merit honorable mention, based on unique features, intelligent design, and/or superior price and performance. From low- to high-end, they are: QMS PS-410, Okidata Okilaser 400, Dataproducts LZR 650, Texas Instruments

CONTINUES

What's in a name?



Hewlett-Packard LaserJet IIP®

Pages per minute	4ppm
Paper handling	
Input	
Standard	50 sheets
Optional	250 sheets 20-capacity envelope tray accessory
Output	
Face down	50 sheets
Face up	20 sheets
Emulations (standard)	HP PCL
Footprint	2.4 sq. ft.
Additional features	
Installation video	Not available
Outline font software	\$99
Remote set-up software	Not available



Dataproducts LZR 650

Pages per minute	6ppm
Paper handling	
Input	
Standard	250 sheets Manual feed (straight paper path)
Optional	250 sheets 40-capacity envelope feeder
Output	
Face down	250 sheets
Face up	30 sheets
Emulations (standard)	HP PCL (LaserJet II) Diablo® 630 Epson™ FX 80 IBM Proprinter™ IBM Graphics Plotter™
Footprint	1.3 sq. ft.
Additional features	
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EDITOR'S CHOICE (continued)

microLaser, Panasonic KX-P4420, Panasonic KX-4450i, Okidata OkiLaser 840, Dataproducts LZR 2450 D, Kyocera F-1800A (18 ppm), and LaserMaster LM 1000.

The best example of an honorable mention printer is the QMS PS-410, one of the personal laser printers based on the ubiquitous 4-ppm Canon LX engine, which means a small footprint, very good print quality, and a tiny paper tray. At \$2,795 list, it's a fair but not outstanding price. The PS-410 provides both Adobe PostScript and PCL support, the ability to have different PCs connected simultaneously to the printer's parallel, serial, and AppleTalk ports, and ESP (Emulation Sensing Processor) that knows whether it's being fed PostScript or PCL code and switches automatically. Every printer should have that feature; only QMS does now.

When we reviewed personal laser printers in the spring (see "A \$1,000 Laser for Every Desktop," June 12, 1990), the \$1,395 Okidata OkiLaser 400 received Editor's Choice. It remains among the very lowest priced lasers (actually, it's an LED array) you can buy, with a street price approaching \$850, superior print quality, and a 4-ppm claimed and PC Labs-verified text speed. But others have caught up, most notably IBM. Okidata's 17 internal fonts mimic older HP font cartridges; we wish the two font-card slots were HP-compatible font-cartridge slots; and you can't upgrade to PostScript. Still a great deal, it deserves honorable mention this time around.

Two ultra-compact personal printers based on the 6-ppm Sharp engine also stand out. The \$1,695 Dataproducts LZR 650 actually runs at 6.4 ppm in PC Labs' text speed test, comes with a 250-sheet paper cassette, allows you to add a second cassette if desired, and it comes with a handy setup/training video. Drawbacks include an inability to

upgrade to PostScript, and the font cards aren't HP-cartridge compatible. The Sharp-engined Texas Instruments microLaser has the same 13- by 14-inch footprint, dual-bin abilities, good print speed, and a fair price—\$1,799 for PCL only and an additional \$1,200 for the 35-font PostScript upgrade.

Panasonic printers run faster and sell better than the competition (except, of course, for HP) in a given price range. The 8-ppm Panasonic KX-P4420 Laser Partner lists for \$1,695 and sells for a little over \$900. At 7.4 ppm text speed and 1.8 gppm graphics speed on PC Labs' tests, Panasonic's performance overwhelms the 4- and 6-ppm personal printers. The 11-ppm Panasonic KX-P4450i lists for \$2,095, has a street price around \$1,300, ran through our speed tests at 10.2 ppm in text mode and 1.8 gppm in graphics mode, and holds 500 sheets in two bins. We wish the Panasonic units were a bit smaller and lighter; we don't (and you won't) like the mess of separate toner refill bottles even if it keeps the cost of consumables down, we'd rather see Panasonic use the industry-standard HP cartridge slots, and a minor bug caused both units to balk at PC Labs' zero-byte graphics test. To its credit, Panasonic will fix the bug and issue new ROM chips to anyone who asks.

Okidata's OkiLaser 840, the \$3,595 PostScript and PCL member of the 800 family, produces a tested text speed of 7.7 ppm from Okidata's 8-ppm LED array engine and an adequate 0.8 gppm on our graphics test. Print quality was especially good, and you can add a second paper bin. But others are more aggressive on pricing; NEC's PostScript/PCL Silentwriter2 90, while a bit slower, is \$1,100 cheaper.

If you need 15 to 20 pages per minute of workhorse print speed, consider the 24-ppm, duplex-printing \$19,995 Dataproducts LZR 2450 D,

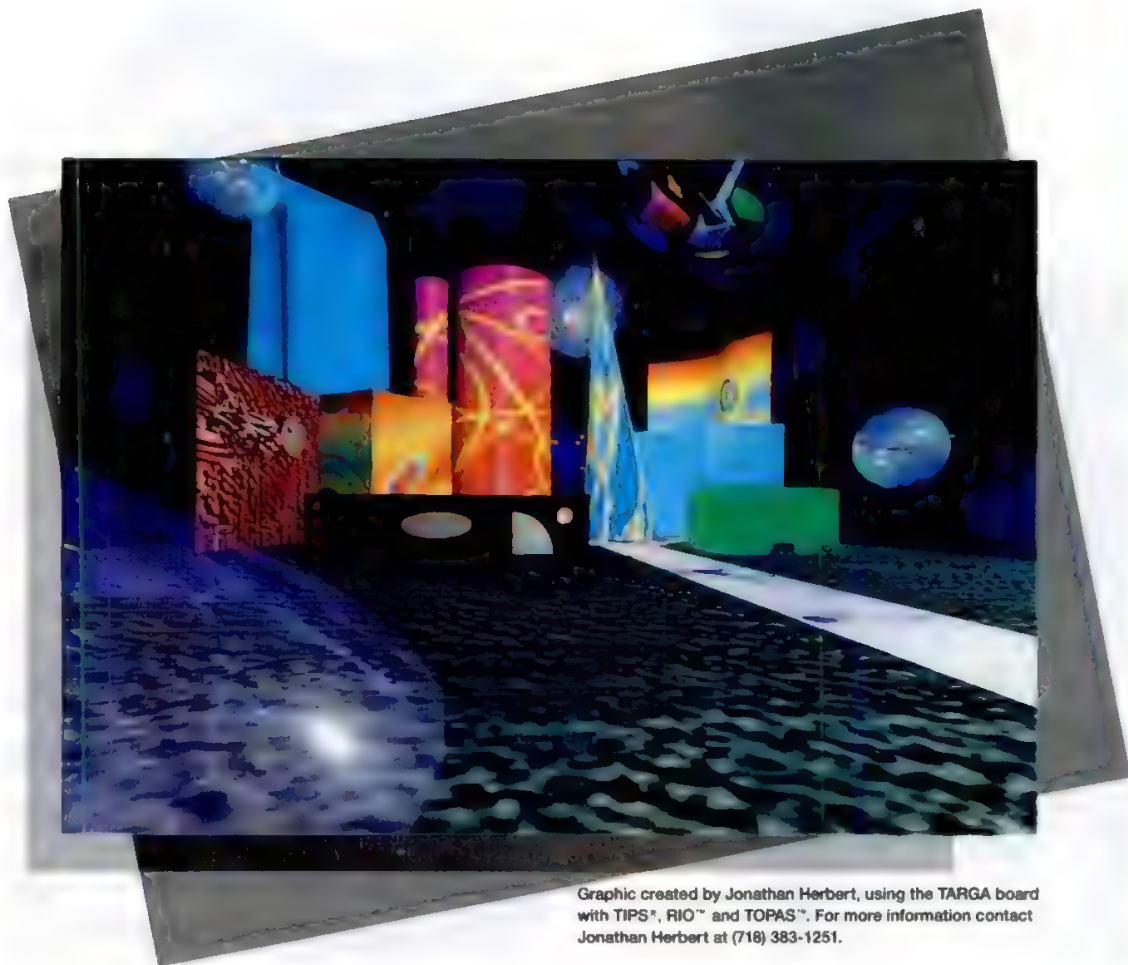
or the 18-ppm \$4,995 Kyocera F-1800A. The 2450 D is rated at 80,000 pages a month (a ream of paper every working hour), and with its tested speed of 18.3 ppm, it could produce two reams an hour if you kept its 250/550-sheet dual bins filled. The 3.6 gppm graphics speed is a PC Labs record. Printing on both sides, plus accurate metering of supplies, should cut the cost of consumables.

For one-quarter the price of the Dataproducts unit, Kyocera gives you five-sixths the print speed on PC Labs' tests: 15.2 ppm and 2.4 gppm. We recommend adding the \$895 1,000-sheet paper bin in place of the 250-sheet tray. One drawback to the Kyocera that shouldn't affect you if you're printing mostly letters: The 79 internal fonts are more arcane than useful. But those of you who need them will like the F-1800A's built-in bar code printing capabilities.

If you want ultra-fast, high-resolution plain paper laser printing, consider the \$7,495 LaserMaster LM 1000. Using a modified Canon SX print engine, it produces clearly better resolution than anything south of a dedicated typesetter. LaserMaster uses fonts that are similar to but not the same as Adobe's 35 main PostScript fonts. If you need perfect visual and typographic compatibility with PostScript devices—for instance if you typeset brochures on a Linotronic typesetter—look elsewhere. But if you do a company newsletter or brochures that won't be typeset again, the LaserMaster is a wonderful value—despite its lack of any of the standard PC printer emulations.

One last note: Print quality has improved so much in the last two years that virtually every one of the 47 laser and laser-like printers we tested produce capable, clean output. Some are better than others, such as HP, and all are completely acceptable.

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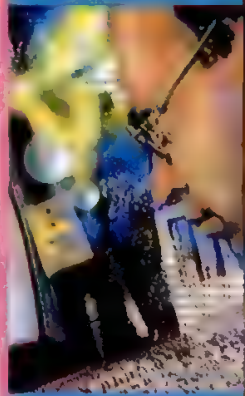
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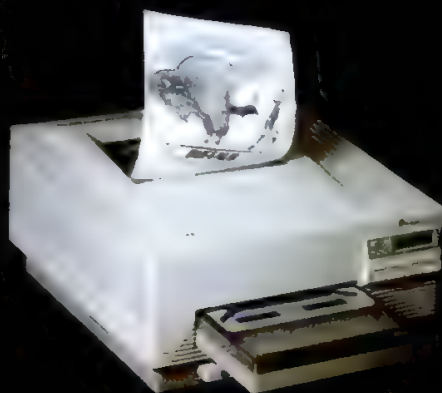


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gppm—slightly slower than the HP IIP's 1.3 gppm, but not so slow as to be unbearable. It should be noted, however, that to complete the graphics speed test, a 1MB RAM upgrade was needed. Without this \$495 option, the 512K standard memory couldn't handle our bitmapped image. Although 512K is fine for text, it's not enough for most graphics jobs.

In fact, the only questionable feature about the LBP-4 is one that it shares with the LaserJet IIP. Both printers come standard with a 50-sheet, fold-down paper tray instead of the much more desirable (and optional for \$195) 250-sheet letter-size bin—a mandatory purchase for all but the lightest printing chores.

Anyone who wants a wonderfully well-rounded printer with a wide variety of application support should stop and take a long hard look at the LBP-4. You'll like what you see.

Canon LBP-8 Mark IIR Canon LBP-8 Mark IIIT by Bill O'Brien

Canon has added two new printers to its LBP-8 Mark III series, and both printers' performances prove that Canon's decision not to include a Hewlett-Packard emulation may have indeed paid off.

Both printers share Canon's LBP-SX 8-ppm engine. The Mark IIIT, priced at

\$3,295, uses the TX engine, and comes standard with 1.5MB of RAM and dual 250-sheet paper cassettes. The Mark IIR, at \$3,795, employs the RX engine, and incorporates all the Mark IIIT's features, adding automatic duplex printing.

The original Mark III printer was reviewed in last year's printer blockbuster and, aside from a drop in price, it hasn't changed. The two new versions share its basic features, including CaPSL—Canon Printer System Language. While not the programming language that is PostScript, CaPSL offers enough cryptic control codes to give PCL a run for its money.

It's these control codes that manage Canon's printing ability, including shading, vector graphics and control over its internal fonts. The bitmapped fonts include the Courier family in plain, bold, and italic and fixed in 12- and 8.16-point sizes. The smaller line printer-like size is supplied in two pitches, 15 and 16.66, and, except for the 15-pitch font, IBM's high order characters are supported.

Canon has included two scalable font families, Dutch-Roman and Swiss, look-alikes of Times Roman and Sans Serif Helvetica. They're provided in normal, bold, and italic. PostScript is available on a cartridge for \$995, and additional bitmapped and scalable fonts can be had as well in cartridges for \$195 to \$295.

Despite the flexibility offered by this selection, the main complaint against CaPSL has always been the near endless stream of control characters needed to access the language's fonts—the same complaint that would be lodged against Hewlett-Packard if not for the widespread support of PCL.

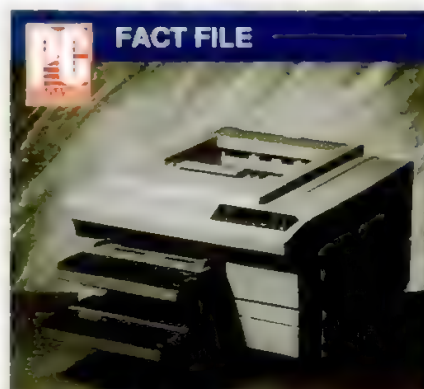
During the last 12 months, however, the world seems to have discovered Canon and Canon itself has done everything it can to meet the world halfway. Fourteen drivers are available, including those for *Windows*, *GEM*, *WordStar*, *MultiMate*, *WordPerfect*, and *Lotus 1-2-3*, thus answering nagging questions of software/hardware compatibility.

The Mark IIIT completed the PC Labs graphics speed test in 1.1 minutes, while the Mark IIR produced 1.0 gppm. The Mark IIIT eked out a slight text-speed advantage at 7.5 ppm compared to the Mark IIR's 7.4 ppm.

The Mark IIR's forte, of course, is duplex printing, and Canon accomplishes this by adding 6 inches to the printer's

length for a paper-exit chute. By setting a front-panel duplex button and turning a mechanical knob on the chute to the duplex setting, paper exits into the chute and then is drawn back into the printer upside down for the duplex print. Although the process seems fraught with the possibility of paper jams, about a hundred sheets went through without a hitch. Be aware, however, that humidity and the quality and condition of the paper will have an impact upon your duplexing success.

Perhaps the only factor that may turn you away from one of these otherwise eye-opening Canon printers is their equally eye-opening price. With an \$800 jump from the base Mark III to the dual tray "T" version and then a \$500 jump to the duplexing "R" model, Canon may have priced itself out of this market. Given the fact that an excellent (if slower) PostScript printer with an HP LaserJet Series II emulation can be had for about the same money, some users may opt to go with the more widely supported page description



Canon LBP-8 Mark IIIIR
Canon LBP-8 Mark IIIT
Canon USA Inc., One Canon Plaza, Lake Success, NY 11042; (800) 848-4123, (516) 488-6700.
List Price: \$3,795 (Mark IIIIR); \$3,295 (Mark IIIT); upgrade to 2.5MB RAM, \$495; upgrade to 3.5MB, \$995; upgrade to 4.5MB, \$1,495; PostScript option, \$995; font cartridges, \$195 to \$295; optional legal, A4, envelope, or executive paper trays, \$75 each; optional secondary letter cassette, \$70; video interface board, \$195.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 12.8 x 17.8 x 26.5 in. (Mark IIIT); 12.8 x 17.8 x 32.5 in. (Mark IIIIR).
Weight: 67 lbs. (Mark IIIIR); 58.3 lbs. (Mark IIIT).
Emulations: Diablo 630, Canon CaPSL.
In Short: Already loaded with bitmapped and scalable fonts, these twin-feed and duplexing (Mark IIIIR only) printers are further enhanced by the availability of an Adobe PostScript cartridge. Their capacity, speed, and performance make them able contenders for network duties.

CIRCLE 402 ON READER SERVICE CARD

FONTS & FEATURES				
Canon LBP-8 Mark IIIIR				
Canon CaPSL				
	Helvetica	Times	Courier	Line Printer
	Underline	Underline	Underline	Underline
	Sub Super	Sub Super	Sub Super	Sub Super
	Italic	Italic	Italic	Italic
	Bold	Bold	Bold	Bold
8/9-point				
10-point				
12-point				
14-point				
Scalable				
Diablo 630				
	Helvetica	Times	Courier	Line Printer
	Underline	Underline	Underline	Underline
	Sub Super	Sub Super	Sub Super	Sub Super
	Italic	Italic	Italic	Italic
	Bold	Bold	Bold	Bold
8/9-point				
10-point				
12-point				
14-point				
Scalable				

language. Nevertheless, these new Canon printers are worthy of consideration.

Dataproducts LZR 650

by Alfred Poor

It's not every day that you get to work with a television star, but that's what happens when you open a Dataproducts LZR-650 laser printer package. This 6-page-per-minute machine not only comes with a \$1,695 list price and a bunch of emulations—it also comes with a video tape in which it plays the leading role.

Some people may be daunted by the high-tech reputation of laser printers, but now that street prices for personal lasers are under \$1,000, more people are considering their first laser. And that's where the video comes into the picture.

The tape may not win an Emmy, but the production is excellent and a clear cut above the typical promotional tape. The program covers all major aspects of operation, from setup and testing through front panel operation.

PRINTERS LASERS

Based on the Sharp print engine, the LZR 650 relies on separate toner and drum components. Setup is fairly easy, but the drum is exposed to damage from mishandling, especially if you must clear a paper jam. The 250-sheet cassette or manual feed will output paper in faceup or facedown positions. A second paper cassette and an envelope cassette are also available options, for \$369 and \$399, respectively.

Although the engine is rated at 6 ppm, the machine was among those rare few that outperformed their specifications in the PC Labs' performance tests. The LZR 650 turned in a 6.4 ppm result, which is nearly two-thirds faster than the HP LaserJet IIP with which it competes.

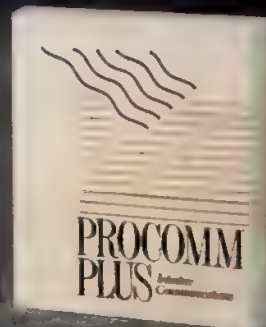
The LZR 650 also offers lots of emulations so that you can be certain it will work with your applications. This is much less of a concern these days, since the HP LaserJet command set is the *lingua franca* for low-end laser printers. But just in case you need them, the printer offers IBM Proprinter and Graphics Printer, Epson FX, and Diablo 630 emulations in addi-

FONTS & FEATURES Dataproducts LZR 650															
HP LaserJet Series II															
Helvetica				Times				Courier				Line Printer			
Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold
8.9-point															
10-point															
12-point															
14-point															
Scalable															
IBM Proprinter															
Bold				Italic				Sub-Super				Underline			
10 cpi															
12 cpi															
Compressed															
Proportional															

tion to HP LaserJet Series II. The printer also comes with a TSR configuration utility that makes it easy to change printer settings and emulations.

The printer has some other nice features. It only uses a small amount of valuable desktop real estate; its feet fit within a 10-inch square. The paper cassette fits entirely within the printer when inserted, so nothing juts out to snag un-

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PERFORMANCE COMPARISON	
CLUB HAWK III (i486-33)	21.0 MIPS
Compaq Deskpro (i486-33)	20.0 MIPS
AST Premium (i486-33)	20.0 MIPS
CLUB HAWK II (i486-25)	17.5 MIPS
Compaq Deskpro (i486-25)	16.0 MIPS
AST Premium (i486-25)	15.0 MIPS
VAX MIPS	

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PC World, Best Buy Award 1989

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PRINTERS

LASERS

wary passersby. Another nice detail appears when you load paper—the spring-loaded base of the cassette locks in the down position to load paper, and then it's released when you reinsert the cassette into the printer. This little detail makes re-loading paper faster and easier.

If the LZR 650 goes light on anything, it is fonts. It has a full complement of those required for the different emulations, but the LaserJet mode only gets the

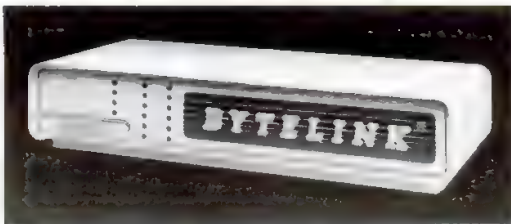
typical Courier and Line Printer fonts. You can add additional fonts easily via the two font card slots on the side of the printer. The LZR 650 comes with 512K RAM, standard, and the possibility of adding more with modules that also fit in the machine's side.

All of this adds up to a personal page printer with impressive credentials. The

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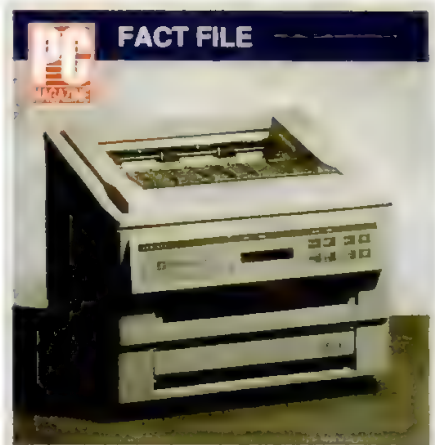
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CIRCLE 342 ON READER SERVICE CARD

FACT FILE



Dataproducts LZR 650

Dataproducts Corp., 6200 Canoga Ave., Woodland Hills, CA 91367-2499; (800) 624-8999.

List Price: \$1,695; upgrade to 1.5MB RAM, \$1,995; upgrade to 4.5MB, \$1,200; font cartridges, \$149-\$239; optional second paper cassette, \$369; optional envelope feeder, \$399

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 10.5 x 13.5 x 14.5 in.
Weight: 33.1 lbs.

Emulations: HP LaserJet Series II, IBM Proprinter, Epson FX, IBM Graphics Printer, Diablo 630.

In Short: The LZR-650 handles more paper faster than most personal laser printers, and at a comparable cost to the competition. It offers only a few fonts but five emulations, and it represents an excellent value in its class.

CIRCLE 404 ON READER SERVICE CARD

video makes it easier for novices to get up and running, the emulations make it versatile. The above-average print speeds give it a productivity edge. In fact, there is little to give up compared with the LZR 650's competitors, aside from the convenience of a unified toner and drum cartridge. If you are in the market for a small, speedy laser printer at a personal price, the Dataproducts LZR 650 might be your ticket.

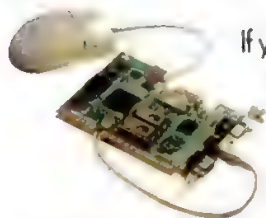
Dataproducts LZR 2450 D

by Alfred Poor

The LZR 2450 D is—literally—a tremendous printer. Weighing in at 161 pounds, it is one of the biggest and heaviest in our roundup. At a list price of \$19,995, it also has one tremendous price tag. And, with its 24-ppm rating, it is certainly one of the fastest. It has one of the largest paper capacities and some of the cleverest paper handling you may have ever seen.



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CIRCLE 540 ON READER SERVICE CARD

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CPU chip.

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is less.



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CIRCLE 508 ON READER SERVICE CARD

The main event here is speed. In the performance timings, the LZR 2450 D managed to hit 18.3 pages per minute on the text speed test in LaserJet emulation, which places it among the fastest printers ever seen in the history of *PC Magazine's* Printer Project. The graphics speed was a blazing 3.6 graphics pages per minute—possibly the fastest time ever. The reason for the zooming throughput is the massive LED-based Kentek print engine. The LZR 2450 D's print quality is excellent, and while areas of solid black tended to become slightly mottled, the effect was hardly noticeable.

The machine is built like a full-size office copier, and setup involved many

complex steps. The documentation was excellent, with plenty of illustrations, so that when a particular step got a little sticky it was easy to stop and study just how all the various parts were supposed to fit together. Once correctly assembled, the machinery was ready to shuffle paper faster than an Atlantic City blackjack dealer.

And there is plenty of room for paper. The machine comes with two paper trays—the bottom one holds 250 sheets, and the top one takes a whopping 550 sheets. Since the LZR 2450 D emulates the LaserJet IID, many programs will be

able to handle bin selection automatically. You can also specify that the printer should switch bins automatically when one runs out of paper.

The similarity with the LaserJet IID doesn't stop there. The "D" in the LZR 2450 D model name refers to "duplex," which means the machine can print on both sides of the page. It manages this trick by sending each sheet of paper on a circuitous route, dropping it momentarily in a special paper bin. Then the sheet is run past the drum again, printing on the second side. For long runs of reports or publishing on demand, this can amount to significant paper savings and at an amazingly small price in speed; duplex printing



PERFORMANCE TESTS: LASER PRINTERS

This year, for the first time, PostScript laser printers outnumbered non-PostScript page printers. The fastest text printer was still a PCL-compatible, though overall PostScripts equalled or outperformed their non-PostScript competition in text mode. As expected, non-PostScript page printers' graphics speeds were generally faster than PostScript lasers'.

This year's crop of laser printers is dominated for the first time by PostScript and PostScript-compatible systems, with a total of 21 such printers being reviewed compared with 18 HP LaserJet or LaserJet-compatible machines. Nonetheless, the fastest printer overall was one running in PCL mode: the Dataproducts LZR 2450 D.

With its Kentek K4 LED-array engine, the Dataproducts LZR 2450 D page printer screamed through PC Labs' text speed test at 18.3 ppm in simplex mode. Running in duplex mode, the Dataproducts lost just over a page per minute, clocking in at 17 ppm; the extra paper handling involved in printing on both sides of the page accounted for the slowdown.

Close on the heels of the Dataproducts was the QMS PS-2210 PostScript printer, running at 17.3 ppm in text mode. The primary difference between the 2210 and the 2450 D can be found not in the emulations but rather in the engine speeds: The 2450 D's engine rated 24 ppm while the 2210 is rated at 22 ppm.

Text performance was essentially similar for both PCL and PostScript printers equipped with Canon SX engines—roughly 7.5 pages per minute in text mode. Notable exceptions to this were the OkiLaser 820 and OkiLaser 840. The 820, a PCL-compatible printer, was one of the few printers that turned in a time faster than the engine's rated speed, running at 8.1 ppm. The 840 running PostScript turned in a time

of 7.7 ppm, not quite matching the engine's rated speed. A combination of a fast RIP (Raster Image Processor) in each machine and efficient paper handling (for an 8-ppm engine) contributed to the excellent throughput.

Other text performances worthy of note were turned in by the Texas Instruments microLaser and the Dataproducts LZR 650. Both use a 6-ppm Sharp engine and each turned in times faster than its rated speed. The microLaser ran at 6.3 ppm in text, the only PostScript printer to run faster than its rated speed. The PCL-compatible Dataproducts LZR 650 ran text at 6.4 ppm. The paper handling on the Sharp engine combined with well-designed RIPs in both systems make these machines real mini-screamers.

In graphics mode, the LaserJet-compatible printers outperformed the PostScript printers, primarily because PC Labs' half-tone test image is a larger file under PostScript than it is in the LaserJet emulation.

One of the fastest graphics performers was the IBM LaserPrinter E, running at 2.2 gppm under its PCL emulation. While the LaserPrinter E are rated for only 5 ppm, the engine and controller are essentially identical to the 10-ppm LaserPrinter (reviewed in last year's printer blockbuster, November 14, 1989). The difference between the LaserPrinter and LaserPrinter E lies in one chip on the printer's controller

board, which slows down text printing but seems to have no effect on graphics printing.

The slowest graphics performer was the Apple Personal LaserWriter NT. It was the only printer tested using a serial interface, which limited transmission of the 700K PostScript test file to 9,600 bps.

Other performance anomalies can be attributed to the PostScript printers that did not have true Adobe PostScript. The Star Micronics turned in a respectable 7.5 ppm on our text speed test but had a graphics speed of only .1 gppm. Its LincPage PostScript board was unable to handle the Windows-generated graphics file efficiently.

The NCR 6436-0501 crawled under its PostScript interpreter, running 3.8 ppm in text and .1 gppm in graphics mode despite its 15-ppm Ricoh engine. Under PCL mode, it fared much better, achieving a respectable 13.4 ppm.

The Qume CrystalPrint Express, using a 12-ppm Sanyo laser engine, ran just 2.6 ppm in our text speed test. We were unable to confirm with Qume the reason for this slowdown at press time.

Finally, the slowest printers tested were the NewGen Systems Corp. TurboPS series printers. Despite their Canon SX engines, they lumbered in at 2.1 ppm. Yet the machines turned in the first- and third-fastest graphics speed times for PostScript printers, indicating that they may have a problem similar to the Qume.

The **Graphics Speed** test measures the time needed to send and print two copies of a graphic image created using *Aldus PageMaker* and *Microsoft Windows*. Results are reported in graphics pages per minute.

The **Text Speed** test measures the time it takes to send and print ten copies of a two-page business letter in 10-point Courier type. The document has a 1-inch margin all around. The laser printers' results are reported in pages per minute.

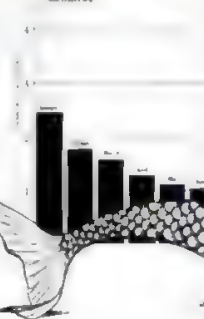
CONTINUES

T

and we can approximate $\partial \mathcal{L} / \partial \mathbf{w}$ by
 using the new elements of $\mathbf{w}$ using
 the new values of $\mathbf{f}$ and $\mathbf{z}$.
 Writing them as $\mathbf{w}^*$
 in place of $\mathbf{w}$ we can proceed

Highlights of 4 key papers

Engineering Operations. The previous year, the company had a turnover of \$400 million and 10,000 employees in 10 countries, including the United States. The company had a turnover of \$400 million and 10,000 employees in 10 countries, including the United States.

[illegible]

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T

The sharp boundary between the two states is the subject of a new study by Michael Susskind of the University of California, Santa Barbara.

† Significant at $p < 0.05$ by Fisher's exact test.

Psychological Operations
Psychological operations was a new idea of the Ministry of National Defense in Japan. In the *Kaitai Zasshi*, a journal of the Ministry of National Defense, the National Security Agency was the Ministry of National Defense's *psychological operations* unit. The unit was responsible for psychological operations, as well as for the *psychological operations* unit. The *psychological operations* unit was the *psychological operations* unit.

2017年10月20日
 2017年10月20日
 2017年10月20日
 2017年10月20日

Problem 1: Show that if A is a set, then
 $\mathcal{P}(A) \cap \mathcal{P}(A) = \mathcal{P}(A)$
 $\mathcal{P}(A) \cup \mathcal{P}(A) = \mathcal{P}(A)$
 and $\mathcal{P}(A) \cap \mathcal{P}(A) = \mathcal{P}(A)$

Leichter sagt die andere ist ein Alp
was für eine was für ein
schöner erger. Bäume
Weg zu Wasser Bäume.

11. *Admission to the board*

and Hosts of Diseases, 1990-98
 (University of Minnesota)

...the ...

also a sign of a strong price
in the market.

Churches

Accepted for publication 15 June 2004

Fig. 1 — *F. s. s.* — *s. s.*

...and the ...

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U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY

1. The first part of the document is a list of names and addresses, which appears to be a directory or a list of contacts. The names are written in a cursive script, and the addresses are listed below them. The list includes names such as "Mr. J. H. Smith", "Mr. W. H. Jones", "Mr. R. H. Brown", "Mr. T. H. Green", "Mr. L. H. White", "Mr. M. H. Black", "Mr. N. H. Gray", "Mr. O. H. Blue", "Mr. P. H. Red", "Mr. Q. H. Yellow", "Mr. R. H. Purple", "Mr. S. H. Pink", "Mr. T. H. Brown", "Mr. U. H. Green", "Mr. V. H. Blue", "Mr. W. H. Red", "Mr. X. H. Yellow", "Mr. Y. H. Purple", "Mr. Z. H. Pink".

1. The first part of the document is a list of names and titles, including "The Hon. Mr. Justice" and "The Hon. Mr. Justice".

100

and her father was

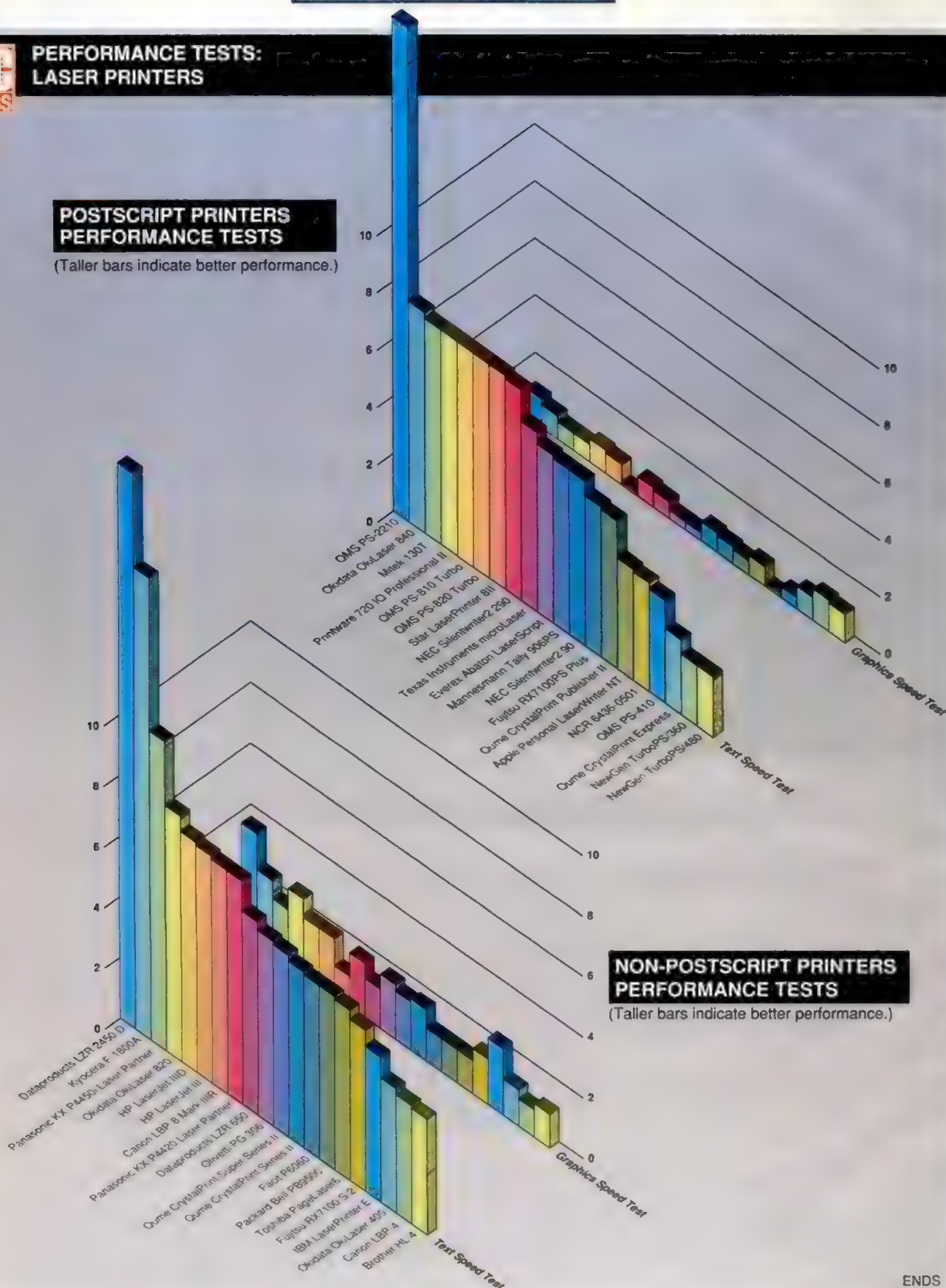
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QMS Inc. One Magnum Pass Mobile, AL 36618

PRINTERS
LASERS



POSTSCRIPT PRINTERS PERFORMANCE TESTS

(Taller bars indicate better performance.)



ENDS

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- **FREE** CompuAdd MS-DOS 4.01

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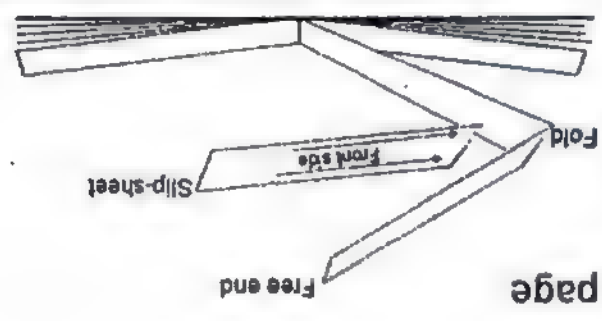


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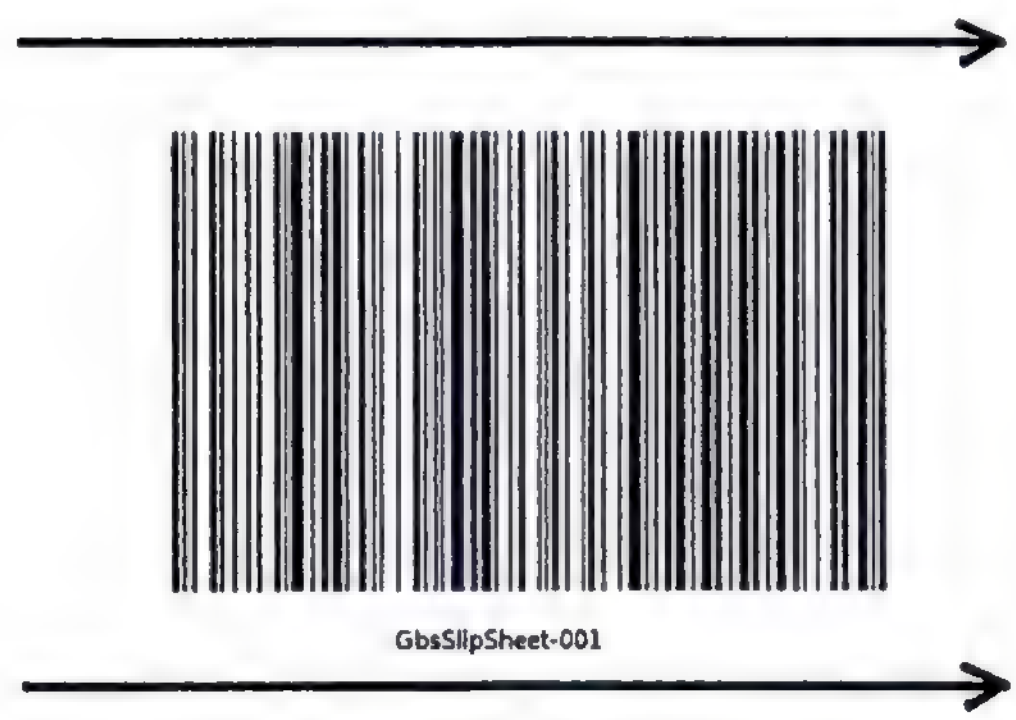
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1. Open the foldout page
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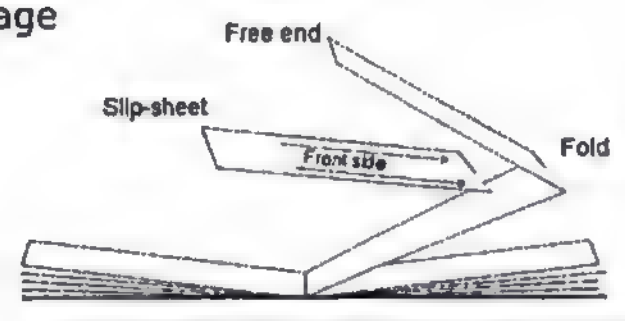
Inverted Foldout slip-sheet



Folded edge of the page

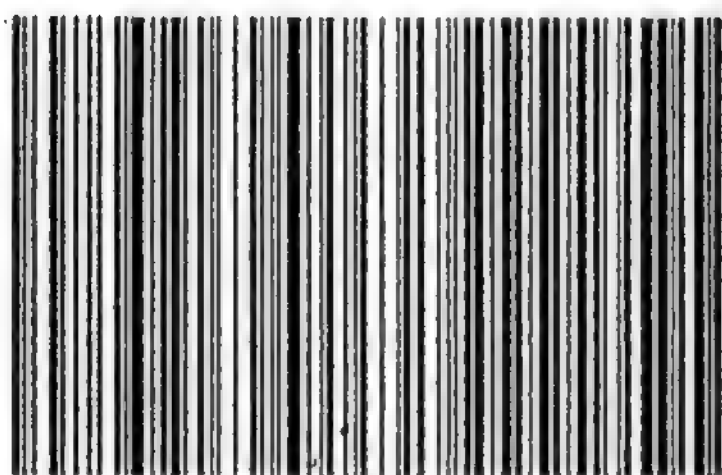
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



GbsSlipBack-0018

Back

1. Follow instructions on the other side

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CompuAdd answers your demands for affordable 386-powered systems — and goes one better with the NEW CompuAdd DX Success Kit.

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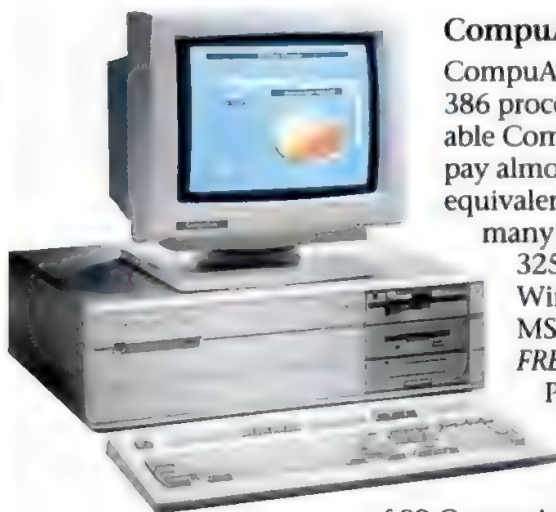


CompuAdd's NEW DX Success Kit Features:

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- ▲ 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- ▲ Dual diskette controller
- ▲ Dual IDE hard drive interface
- ▲ Six 16-bit and two 8-bit expansion slots
- ▲ Five 5.25" half-height drive bays
- ▲ Built in parallel and two serial ports
- ▲ High performance monitor and graphics adapter
- ▲ **FREE** Panasonic KX-P1180 printer
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- ▲ **FREE** CompuAdd Windows 3.0 preloaded
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CompuAdd 325 Features:

- 80386 microprocessor rated at 25MHz (8MHz, and 25MHz)
- 1MB DRAM expandable to 16MB
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FONTS & FEATURES

Dataproducts LZR 2450 D

HP LaserJet Series II																			
Helvetica					Times					Courier					Line Printer				
Underline	Sub-Super	Italic	Bold		Underline	Sub-Super	Italic	Bold		Underline	Sub-Super	Italic	Bold		Underline	Sub-Super	Italic	Bold	
8/9-point																			
10-point																			
12-point																			
14-point																			
Scalable																			

sion for feeding paper manually. The HP LaserJet emulation comes with Courier, Courier Bold and Italic, and Line Printer. The emulation is loaded from a 3.5-inch disk inserted into the depths of the printer—this printer actually boots up from a disk—and the unit comes with Diablo 630 and DEC LN03 emulations on disk as well. These are hardly mainstays of the micro world these days, but are of more value in the minicomputer world.

And that points to where this printer belongs. It is a workhorse, built to print 80,000 pages a month. The LZR 2450 D belongs on the print server for a network where thousands of pages of printouts must be churned out every 30 days. The LaserJet compatibility means support for most micro applications, and the duplex printing and large paper capacities make for long runs without operator attention.

If you have heavy printing requirements and enough users to support the investment, then the Dataproducts LZR 2450 D might be the heavy-weight you need in your corner.

Everex Abaton LaserScript by Joseph F. Rizzo

Although a company representative claims that the Abaton Division will discuss setting a selling price lower than its \$2,995 list, note that the very same printer can be acquired from the Quill Corp. (100 Schelter Rd., Lincolnshire, IL, 60069-3621. ((708)) 634-6690) for \$2,498. Both printers are called LaserScript and are manufactured by Everex Systems Inc. In fact, the two printers we tested were only 20 serial numbers apart. Both printers function identically and produce the same test results.

The LaserScript features a built-in HP LaserJet Series II emulation, with 24 internal fonts. It also supports LaserJet Series II applications with PCL-resident, bit-mapped fonts, and two HP-compatible font cartridge slots.

The LaserScript also comes with a built-in PostScript emulation—the Microsoft/Bauer PostScript language interpreter—and Bitstream PostScript-compatible scalable outline fonts, as well as 35 PostScript fonts. When you order, the factory sets the printer's default emu-

lation to your specifications.

The LaserScript is extremely easy to assemble, and includes straightforward documentation. The drum and the toner cartridge need to be placed in a tray and then inserted in the printer. Add the clean-

**The LaserScript is
designed to be a
multiuser printer. The
two available I/O
configurations both
sport four ports.**

ing pad and drum counter, connect either a Centronics or serial (or AppleTalk, if you have a Macintosh) cable, fill the paper tray with up to 150 sheets of 16- to 27-pound paper, and you are all set to start printing.

The LaserScript is designed to be a multiuser printer. There are two available I/O configurations, both sporting a total of four ports: one parallel, two serial, and one AppleTalk, or three serial ports and one AppleTalk. You'll need to ask for the I/O board of your choice when you order your printer. You can, however, change the I/O board yourself.

The Abaton LaserScript come with 3MB of RAM. An additional 3MB, in increments of 1MB-SIMMs, can be in-



Dataproducts LZR 2450 D

Dataproducts Corp., 6200 Canoga Ave., Woodland Hills, CA 91367-2499; (800) 624-8999

List Price: \$19,995; optional second 3.5-inch drive, \$475; optional sheet feeder, \$1,495; optional output stacker, \$1,495.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 16.5 x 48 x 20 in.

Weight: 161 lbs.

Emulations: HP LaserJet Series II, Diablo 630, DEC LN03 Plus.

In Short: The biggest, fastest, heaviest—and one of the most expensive—printers in this year's roundup, the LZR 2450 D cranks out a ton of pages and qualifies as a superb network printer.

CIRCLE 403 ON READER SERVICE CARD

FONTS & FEATURES

Everex Abaton LaserScript

PostScript emulator																			
Helvetica					Times					Courier					Line Printer				
Underline	Sub-Super	Italic	Bold		Underline	Sub-Super	Italic	Bold		Underline	Sub-Super	Italic	Bold		Underline	Sub-Super	Italic	Bold	
8/9-point																			
10-point																			
12-point																			
14-point																			
Scalable																			

HP LaserJet Series II																			
Helvetica					Times					Courier					Line Printer				
Underline	Sub-Super	Italic	Bold		Underline	Sub-Super	Italic	Bold		Underline	Sub-Super	Italic	Bold		Underline	Sub-Super	Italic	Bold	
8/9-point																			
10-point																			
12-point																			
14-point																			
Scalable																			

stalled on the I/O board. The printer can be used simultaneously by up to three PCs and a Macintosh. You can set a priority level for each port via the front panel.

**Though the LaserScript
is too slow to be a
good network printer,
it can be shared among
three or four people in
close proximity.**

Although Abaton claims that the LaserScript's TEC engine's speed is 6 ppm, the actual test time for our text speed test was 5.2 ppm under the HP LaserJet Series II emulation. The PostScript emulation came in at an impressive text speed of 5.8 ppm. While the results are too slow to make this a good network printer, it is the kind of printer that can be satisfactorily shared among three or four people in close proximity. At its claimed resolution of 300 dpi, the printer did very well in both HP and PostScript modes when it came to printing graphics, scoring speeds of 1.2 gppm and 0.3 gppm, respectively.

The front control, with its 32-character LCD, is simple to operate. The LCD is

PRINTERS LASERS

divided into four parts; top left displays the emulation; top right displays the paper size; bottom left displays on- or off-line and error messages; the bottom right displays the currently active I/O interface. There are two sets of operation buttons on the front panel. The four on the left are used to configure all of the possible options which will then appear on the LCD. The four keys on the right are used to take the printer on- and off-line, adjust the paper thickness (by using the envelope key), select manual feed, and reset the printer. The manual includes full flow-chart diagrams showing how to select each option.

If you can get this printer for under \$2,500 it might be a good addition to a small office or area where three or four people need to share a printer. Its excellent output quality and easy setup make it worthy of consideration.

Facit P6060

by Bruce Brown

Facit's P6060 is representative of the group of relatively low-cost, 6-ppm Hewlett-Packard LaserJet Series II-compatible laser printers. This unit is about as bare bones as they come, but its \$1,599 list price will probably be discounted to \$1,000 or so. Nothing about the Facit unit is particularly outstanding, but you get what the vendor promises: HP compatibility, simple operation, and low price.

The 512K RAM P6060 weighs just 35 pounds and measures approximately 8 by 25 by 16 inches (HWD). Parallel and serial ports are standard, as is the Hewlett-Packard LaserJet Series II emulation. An IBM Proprinter XL emulation cartridge is available as a \$239 option. The P6060 employs the Tokyo Electronics Company's (TEC) 300-dpi laser engine, one often used in 6-ppm printers. This engine has a rated life of 300,000 printed sheets and a maximum duty cycle of 4,000 pages per month. According to Facit, the cost per page over the expected life of the printer is 3.4 cents, including hardware and consumables, but not paper. Consumable costs alone are 2.9 cents per page.

Typical of other printers with the TEC laser engine, the P6060 achieved a speed of 5.7 ppm on our 20-page text speed test. On the graphics speed test the Facit per-

formed at a respectable rate of 1.1 ppm. The printer passed our HP compatibility torture test, proving its manufacturer's Series II compatibility claims. The graphics output on the speed and emulation tests was similar in quality to standard HP printed graphics.

The P6060 comes with the same resident fonts and typefaces as the HP LaserJet Series II: portrait and landscape Courier 10, Courier 10 Bold, and Line Printer. You can use downloaded or soft fonts intended for LaserJet Series II printers. Facit sells 22 different font cartridges ranging in price from \$159 to \$219, and downloadable font sets for \$189. The Facit P6060 also accepts standard HP font cartridges. Downloading fonts takes up precious memory and full-page bitmapped graphics at 300 dpi require more than the

FONTS & FEATURES

Facit P6060

HP LaserJet Series II											
Helvetica			Times			Courier			Line Printer		
Underline	Sub Super	Italic Bold	Underline	Sub Super	Italic Bold	Underline	Sub Super	Italic Bold	Underline	Sub Super	Italic Bold
8.9-point											
10-point											
12-point											
14-point											
Scalable											

Facit P6060's standard 512K memory. Memory expansion options are available from Facit in increments of 1MB for \$329 including the memory board, 2MB for \$489, and 4MB for \$799.

The Facit P6060's standard 150-sheet paper tray works with both letter- and legal-size paper and includes an adjustable-width paper guide for feeding envelopes one at a time. An optional \$1,299 dual-bin paper cartridge holds 220 sheets in each bin. Paper feeds straight through the P6060. As with most laser printers you can select facedown or faceup paper delivery. If you want the sheets to come out faceup they'll drop on your desk or table unless you buy a \$39 faceup tray. The printer works with paper ranging from 14 to 34 pounds, but with the lightest and heaviest paper you must use manual feed—a restriction shared by most laser printers.

The Facit's front control panel includes a 16-character liquid crystal display and eight membrane switches. The most frequent reason to use the switches and display panel is to change fonts and to switch



Everex Abaton LaserScript

Everex Systems Inc., Abaton Division, 48431 Milmont Dr., Fremont, CA 94538; (800) 444-5321.

List Price: \$2,995; optional faceup tray, \$50.
Standard Warranty: One year on parts and labor with 90 days free on-site service.

Dimensions (HWD): 8.5 x 24.3 x 16.3 in.

Weight: 35.3 lbs.

Emulations: PostScript emulator, HP LaserJet Series II.

In Short: The LaserScript is easy to set up and change and has very good HP Series II and PostScript emulations. If the price is right, this could be a welcome addition to a small office.

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Robert Cullen, Home Office Computing

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***Limitations:** Over 20 monthly transactions involve a nominal surcharge (\$3 per ten payments or portion thereof).

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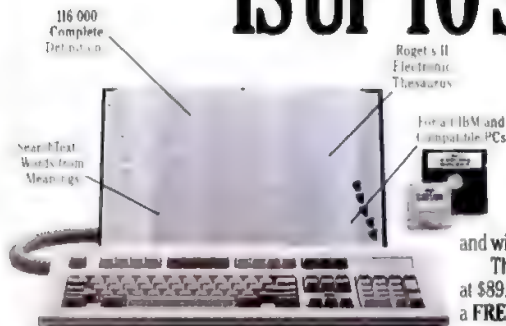
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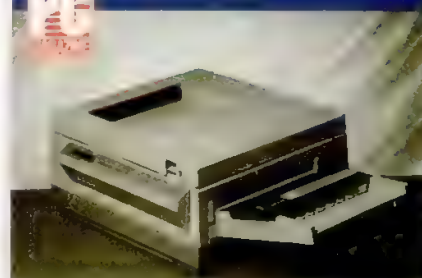
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FACT FILE



Facit P6060

Facit Inc., 400 Commercial St., Manchester, NH 03108; (800) 733-FACIT, (603) 647-2700.

List Price: \$1,599; upgrade to 1MB RAM, \$189; upgrade to 2MB, \$329; upgrade to 4MB, \$489; emulation cartridge, \$239; font cartridges, \$159-\$219; optional sheet feeder, \$1,299.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 8.8 x 24.8 x 16 in.

Weight: 35.3 lbs.

Emulations: HP LaserJet Series II.

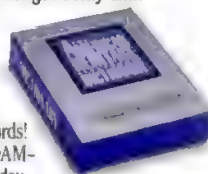
In Short: Priced to compete with the Hewlett-Packard LaserJet IIP, the Facit P6060 is rated at 2 pages per minute faster than the IIP, is HP LaserJet Series II compatible, and comes with a standard legal and letter-sized paper tray. Aside from a three-piece toner-and-developer setup, this printer certainly gives the IIP a run for its money.

CIRCLE 407 ON READER SERVICE CARD

between emulations. Most people will seldom change the settings, but the Facit's menu system is simple and makes changes easy.

Setting up the P6060 can be a little tricky. To get started, you'll put the separate drum and developer units into a removable basket, invert the toner cartridge on the drum cartridge, and pull out a toner release strip. If you're reasonably careful you won't get toner on your hands. Fortunately the documentation has clear instructions for installing consumables as well as for using other operational features and functions. Toner cartridges are good for 1,500 copies and cost \$24 each; the replacement drum cartridge, which must be changed every 10,000 sheets, costs \$126.

Two years ago, the Facit P6060 would have been big news. Today its minimal features list makes it less competitive than printers that use the same laser engine but whose manufacturers include more fonts and emulations. On the other hand, the P6060 is faster than the similarly priced 4-ppm Hewlett-Packard LaserJet IIP. If speed, price, and HP compatibility are a concern, the P6060 might make a wise choice.



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MTBF (Hours)	60,000	<25,000	60,000
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CIRCLE 317 ON READER SERVICE CARD

Fujitsu RX7100PS Plus Fujitsu RX7100 S/2

by Tom Unger

Last year's versions of Fujitsu's RX7100 line—the RX7100 and RX7100PS—got good grades in our November 14, 1989, printer issue. Clear output, ease of use, and reasonable if not eye-popping prices made them contenders in the emerging personal laser printer market. Although what's changed in this year's versions is not immediately apparent, what's new is significant enough to place these printers among this crop's top competitors.

The most important new feature in the RX7100 line is price. The RX7100 S/2, formerly priced at \$2,150, now goes for

PRINTERS LASERS

just \$1,395—the lowest-priced personal laser in our roundup. You may well be able to pick one up from your local dealer or a mail-order house for under a \$1,000. Fujitsu has added three more emulations to the RX7100 S/2's standard Hewlett-Packard LaserJet II emulation: IBM Proprinter XL, Epson FX, and Diablo 630 ECS. According to PC Labs' tests, you get crisp 300-dpi output from Fujitsu's own 5-ppm M3701M LED electrophotographic print engine, speedy 5.3-ppm text output, and 1.5 gppm in the HP LaserJet Series II emulation.

The RX7100 S/2 comes with 640K memory onboard and can be upgraded in \$495 increments of 1MB to 4.6MB for \$1,980. The RX7100 S/2 comes with one 150-sheet feeder, but you can add another for just \$147—a significant decrease from last year's optional second bin price of \$405. The machine accepts three of Fujitsu's proprietary font cards at one time. There are 27 cards for the RX7100 S/2, containing from one to four fonts per card. Each font card costs \$145, although Fujitsu bundles six two-card sets for \$195 each.

The RX7100PS Plus, a true Adobe PostScript printer, has experienced a similar dive in price, from \$4,495 to \$3,790. And while its only other improvement concerns memory capacity, the improvement is once again significant. Last year's RX7100PS came with 2MB of memory that wasn't subject to upgrades; the PS Plus comes with 4MB memory standard—enough memory to handle even the most demanding PostScript jobs. In HP LaserJet Series II mode, the printer performed identically to its RX7100 S/2 sibling, and its 5-ppm engine performed admirably in PostScript mode, which produced a graphics page in about 0.6 gppm.

The printers are otherwise identical. Both use the same \$185 toner and drum cartridge rated at 6,000 pages and the same six-membrane-button control panel sporting a 16-character LCD and four LED indicators. The control panel is simple to use and cycles through a series of branching menus to change everything from emulation to interface. Both use the same low-slung, small-footprint case and top-drop paper-feed bins. Fujitsu's documentation is clear and includes excellent setup diagrams and instructions. In fact, so similar are these machines that, accord-

Fujitsu RX7100PS Plus															
PostScript															
Helvetica				Times				Courier				Line Printer			
Underline	Sub	Super	Italic	Underline	Sub	Super	Italic	Underline	Sub	Super	Italic	Underline	Sub	Super	Italic
Bold				Bold				Bold				Bold			
8/9-point															
10-point															
12-point															
14-point															
Scalable															
HP LaserJet Series II															
Helvetica				Times				Courier				Line Printer			
Underline	Sub	Super	Italic	Underline	Sub	Super	Italic	Underline	Sub	Super	Italic	Underline	Sub	Super	Italic
Bold				Bold				Bold				Bold			
8/9-point															
10-point															
12-point															
14-point															
Scalable															



Fujitsu RX7100PS Plus
Fujitsu RX7100 S/2

Fujitsu America Inc., 3055 Orchard Dr., San Jose, CA 95134-2022; (800) 626-4686, (408) 432-1300.

List Price: \$3,790 (RX7100PS Plus); \$1,395 (RX7100 S/2); upgrade to 1.6MB RAM, \$495 (RX7100 S/2); upgrade to 4.6MB, \$1,990 (RX7100 S/2); PostScript option, \$3,300 (RX7100 S/2); emulation cards, \$99-129, font cards, \$145-\$350; optional faceup stacker, \$245 (RX7100PS Plus); optional second feeder-bin attachment, \$147 (RX7100 S/2).

Standard Warranty: One year on parts and labor, first 45 days on-site.

Dimensions (HWD): 20.5 x 16 x 15.5 in. (both units).

Weight: 43.9 lbs (RX7100PS Plus); 39 lbs. (RX7100 S/2).

Emulations: PostScript (option on RX7100 S/2), HP LaserJet Series II, IBM Proprinter (RX7100 S/2 only), Epson FX (RX7100 S/2 only), Diablo 630 (RX7100 S/2 only).

In Short: Improvements in the area of price are of equal importance to improvements like memory upgrades and additional fonts in these new iterations of the RX7100 line. The RX7100 S/2 is one of the least expensive laser printers available but it produces expensive-looking output. Check it out.

CIRCLE 406 ON READER SERVICE CARD

ing to a Fujitsu representative, the RX7100PS Plus is actually an RX7100 S/2 with a \$3,300 user-installable PostScript controller card—not that such a move would be price-wise.

What made these printers notable—if expensive—last year, makes them stand-outs this year because they're no longer expensive. This is especially true of the RX7100 S/2, with its three added emulations and expected less-than-\$1,000 street price. If you're looking for an inexpensive personal laser printer, the RX7100 S/2 will be hard to pass up. The RX7100PS Plus, with true Adobe PostScript and 4MB of onboard memory, is in the thick of the personal PostScript competition as well. Give them both a close look.

HP LaserJet III HP LaserJet IIID

by Alfred Poor

Hewlett-Packard has owned the micro-computer laser printer market since it invented the class with the original LaserJet seven years ago. It's getting harder to stay out in front of the pack, however, as prices drop and feature lists grow. Nevertheless, HP is doing its best by offering the LaserJet III and LaserJet IIID—two 8-ppm printers based on proven Canon engines—with list prices of \$2,395 and \$3,595, respectively. And, as it has shown in the past, HP's best can be excellent indeed.

The fundamentals remain the same as



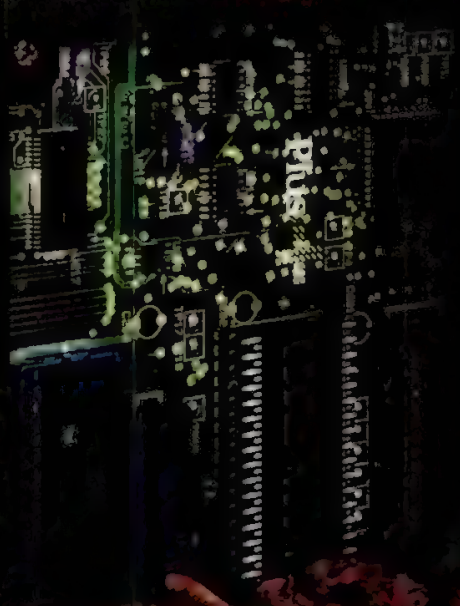
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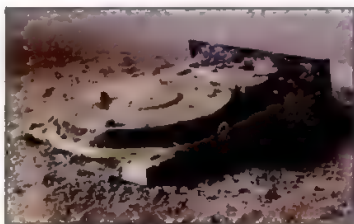


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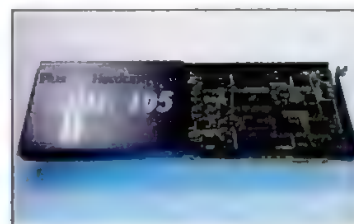
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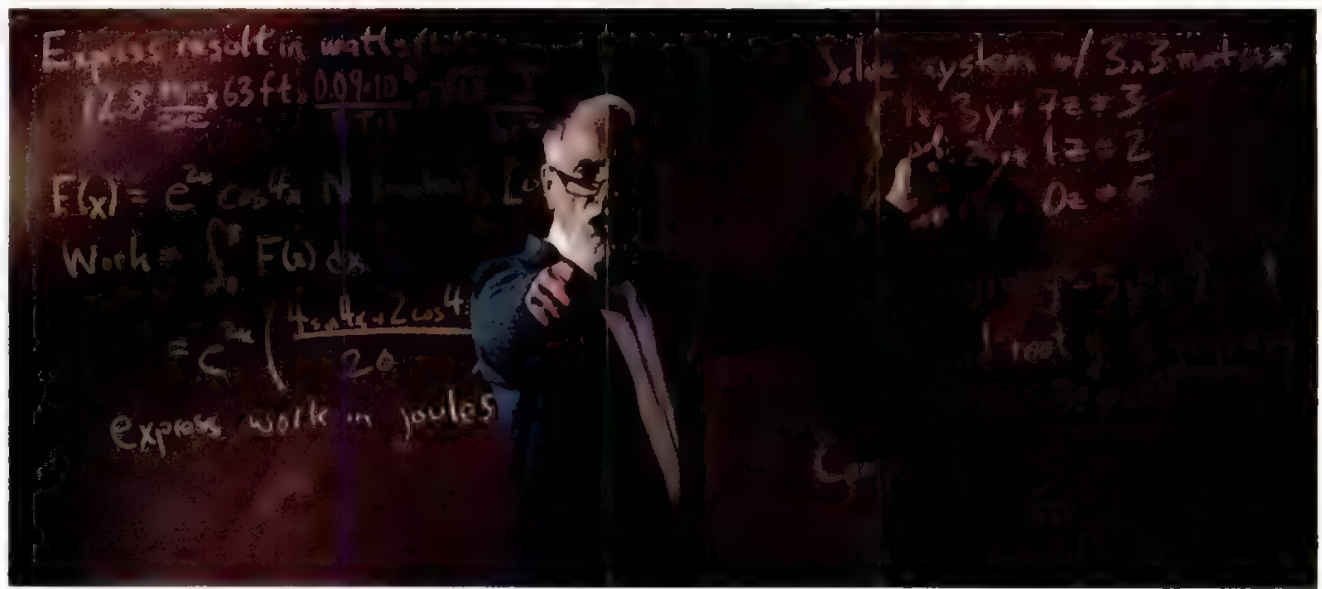
XL
HARDCARD II XL

Plus 

CIRCLE 283 ON READER SERVICE CARD

1. Effective access time is the typical application access time using DisCache[®]. 2. As measured by Power Meter on a Compaq Deskpro 386 33MHz system.
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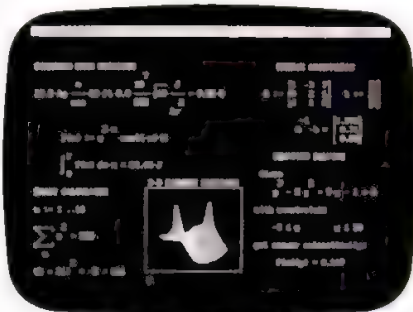
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with the Series II and IID printers—models these new printers replace. The print engines are the same; the IID has two paper trays and can perform duplex printing (printing on both sides of a sheet of paper) just as the IID did. Both offer parallel and serial ports; both rely on HP's Printer Command Language (PCL).

Some of the changes are also cosmetic: The Canon engines are wrapped in attractive new housings, with squared-off lines. These cosmetic changes are not always merely superficial—the paper trays are easier to handle, for example, thanks to a recessed handle along the bottom front edge.

The real changes are inside. The printers offer two important new features that aren't yet available on any other printer: support for HP's PCL 5, and Resolution Enhancement Technology.

PCL has grown and expanded over the years; the LaserJet Series II supports commands through level four of the language. But PCL 5 adds important new capabilities for the LaserJet III and IID that put them head and shoulders above the LaserJet Series II standard they replace.

PRINTERS LASERS

PCL 5 includes support for scalable fonts. Until now, this feature was only available on PostScript or PostScript-emulating printers and a handful of ma-

bold, italic, and bold italic forms: CG Times, which is similar to Times Roman, and Universe, similar to Helvetica.

You can print characters in any direction on the page, and mix portrait and landscape characters on the same page for the first time with a LaserJet under PCL. PCL 5 also includes support for HPGL/2 commands, as used by HP pen plotters, making it faster and more powerful for printing graphics. Since these two printers can convert text to HPGL outlines, you are also able to perform fancy font effects, such as printing on an angle, white letters on a black background, and even printing letters filled with patterns or with complex drop shadows. The printers also support three different methods that compress bit-image print streams, which should result in faster graphics printing.

The other big news is Resolution Enhancement Technology. Most print engines make the same size dot in the same relative position for each of the 90,000 possible spots per printed square inch. HP's Resolution Enhancement feature can vary the size of the dot and its horizontal alignment, which greatly reduces the jagged edges seen on curved

FONTS & FEATURES																
HP LaserJet III and IIID																
HP LaserJet Series II																
	Helvetica				Times				Courier				Line Printer			
	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold
8.5-point																
10-point																
12-point																
14-point																
Scalable																

chines with their own proprietary languages. HP has incorporated Intellifont technology developed by AGFA Compugraphic that permits scaling fonts from a quarter point to nearly 1,000 points. (With 72 points to the inch, a 720-point character would be about 10 inches tall.) Both the III and IID come with two internal sets of font outlines in upright,

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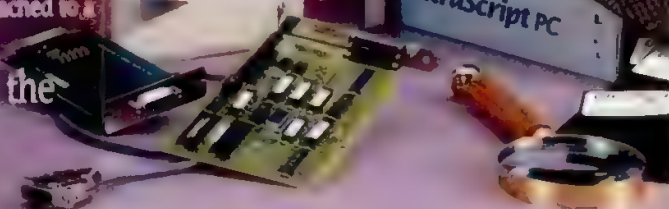
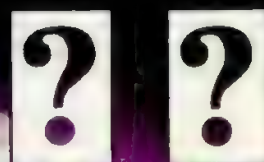
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PRINTERS **LASERS**

mance tests do not take advantage of the III and IIID's ability to handle compressed bitmapped graphics or HPGL/2 vector graphics, both of which can result in better performance.

The latest generation of LaserJets has more to offer than its predecessors, but the best news is that they cost less than their LaserJet Series II counterparts. As a result, they provide outstanding value that is difficult to beat. HP has proven once again that it can stay a step ahead—at least for this round.

IBM LaserPrinter E

by Stephen W. Plain

Introduced as a more affordable 5-ppm version of last year's entry from IBM—the IBM LaserPrinter—the LaserPrinter E has arrived with a slew of impressive features and solid original design.

The \$1,495 LaserPrinter E's appeal comes from the fact that it's the printer to buy if upgrades are among your main concerns. With a \$449 1MB memory upgrade from the printer's standard 512K and the \$499 standard PostScript option, you can have genuine Adobe PostScript with 17 typefaces.

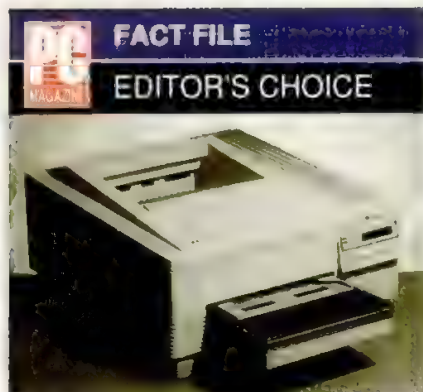
The PostScript option comes in the form of a plug-in replacement daughterboard for the four ROM chips on the interface board. The installation is a snap; a panel on the right side of the printer opens up via two finger tabs to expose the interface board. Since the PostScript option involves direct incorporation onto the interface board, you don't get the sluggish speeds of some cartridge-oriented PostScript solutions. For \$899, you can obtain the Premium PostScript option, which includes a font card that adds 22 more outline fonts for a total of 39.

Two slots are available on the front of the unit for use with the 48 optional IBM font cards that cover a broad spectrum of typefaces and are priced from \$142 to \$245. IBM also offers a \$1,099 upgrade option to make your LaserPrinter E the 10-ppm equivalent of its higher-end LaserPrinter sibling. A printer-sharing option is available for \$489, enabling you to share the LaserPrinter E's resources among six machines via serial interfaces.

The LaserPrinter E defaults to IBM PPDS mode, but also emulates the HP

LaserJet Series II, IBM Graphics Language, and HPGL. The PC Labs graphics test produced crisp graphic samples in all of its modes. Our text speed test produced 4.8 ppm in HP LaserJet Series II mode, and 5.8 ppm with the PostScript option installed.

The LaserPrinter E comes with a 200-page paper drawer which slides into the bottom front of the printer, hardly adding to the printer's basic 10.5-by-14.3-by-27-inch (HWD) case. A 500-page second drawer option, which neatly fits underneath the standard drawer, is available for \$399. The IBM engine is excellently engineered, offering an S path to collated output in the printer's top catch bin, or a C path for reverse output onto the front tray. Also included is a manual feed tray, which fits into the back of the unit and allows for straight-through output. IBM also offers



**HP LaserJet III
HP LaserJet IIID**

Hewlett-Packard Co., 19310 Prunewidge Ave., Cupertino, CA 95014; (800) 752-0900.

List Price: \$2,395 (LaserJet III); \$3,595 (LaserJet IIID); upgrade to 2MB RAM, \$335; upgrade to 3MB, \$560; upgrade to 4MB, \$895; upgrade to 5MB, \$1,120; PostScript option, \$695; font cartridges, \$99-\$399; downloadable fonts, \$99-\$200; Appletalk interface kit, \$275; optional envelope tray (for the III), \$89; envelope feeder (for the IIID), \$350.

Standard Warranty: One year on parts and labor (LaserJet III); One year on-site parts and labor (LaserJet IIID).

Dimensions (HWD): 10.0 x 18.0 x 25.5 in. (LaserJet III); 13.8 x 18.3 x 32.5 in. (LaserJet IIID).

Weight: 50 lbs. (LaserJet III); 75.9 lbs. (LaserJet IIID).

Emulations: HP LaserJet Series II.

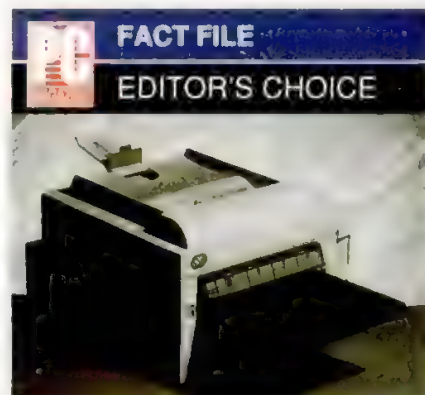
In Short: The LaserJet III and IIID extend Hewlett-Packard's lead in the desktop laser market. The added capabilities of PCL 5 and improved output quality make these printers winners. Unless you need the duplex printing or paper capacity of the IIID, the III represents the better value.

CIRCLE 409 ON READER SERVICE CARD

and angled lines. While it has no effect on half-tone images, this technology can result in remarkable improvement for text and line art.

There are also important options available with these printers. You can add up to another 4MB of RAM to the standard 1MB. You need a 2MB addition to use HP's \$695 PostScript upgrade cartridge; the IIID needs a full 4MB upgrade to use the duplexing feature with PostScript. The IIID also offers a separate envelope feeder. Memory upgrades range from 2MB to 5MB and cost between \$335 and \$1,120.

The only thing unremarkable about these printers is their performance. At 7.5 and 7.6 ppm, respectively, in their native PCL mode, and 7.4 ppm under PostScript, they're about average for lasers rated at 8 ppm. The duplexing feature on the IIID slows output to 6.4 ppm under PCL. The PCL graphics times of about 1.9 gppm are also typical for this class of engine, but keep in mind that the PC Labs perfor-



IBM LaserPrinter E

IBM Corp., 1133 Westchester Ave. White Plains, New York 10604 (800) IBM-2468.

List Price: \$1,495 including 8.5 x 11-inch paper tray and print cartridge; upgrade to 1.5MB RAM, \$449; upgrade to 2.5MB, \$899; upgrade to 4MB, \$1,599; standard PostScript option, \$449 (requires minimum 1MB upgrade); Premium PostScript option (39 outline fonts), \$899 (requires minimum 1MB upgrade); font cards, \$142 to \$245; upgrade to 10 ppm, \$1,099, six-port serial printer-sharing option, \$489; optional 200-page legal tray \$69; optional 500-sheet feeder draw, \$399; optional 500-sheet legal paper tray \$99; optional 75-envelope feeder, \$329; toner and drum print cartridge, \$199; downloadable font packages, \$199; 128K font card, \$142; 256K font card \$245.

Standard Warranty: One year on parts and labor with carry-in repair service; on-site repair and extended warranty are optional.

Dimensions (HWD): 10.5 x 14.3 x 27 in.

Weight: 33.6 lbs.

Emulations: HP LaserJet Series II, HPGL, IBM PPDS, IBM Graphics.

In Short: Street-priced under \$1,000, the IBM LaserPrinter E offers thoughtful design in a highly upgradable package. Feature for feature, it stands above its chief competitor—the HP LaserJet IIP—making it a clear leader in its class.

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THE LATEST IN LASER LANGUAGE: PCL 5

Hewlett-Packard's most recent version of its printer command language, PCL 5, includes scalable fonts and eliminates most of the major differences between PCL and Adobe PostScript.

by Alfred Poor

The first year of the new decade was a watershed year for the laser printer market. There were dozens of product announcements, new price/performance points were established, and printer languages became more powerful and less expensive. This plethora of choices all adds up to potential confusion, but it also means you will get more for your dollar.

Hewlett-Packard fired one of the main shots in the language wars last winter when it released its new LaserJet III. Among the LaserJet III's innovative features was a new version of Hewlett-Packard's Printer Command Language: PCL 5.

FLEXIBLE COMMAND LANGUAGE

PCL was invented by HP back in the early 1980s. This new set of printer commands was designed to support HP's full range of printers, from impact dot matrix to laser to color ink jet. The idea was to create a flexible and extensible language that could take advantage of features offered by different print technologies.

The original LaserJet printer supported commands through PCL level 3, plus a few extra commands. The LaserJet Plus added support for PCL level 4 commands, which included advanced features such as downloadable "soft fonts" and macros, and the LaserJet 500 Plus introduced extensions that were capable of supporting multiple input trays.

Both the LaserJet Series II and IID were breakthrough products in terms of size and pricing, but they essentially supported the same commands as the LaserJet Plus and LaserJet 500 Plus printers. The LaserJet III arrived with support for PCL 5, and is therefore

capable of four important new sets of features: scalable fonts, font effects, vector graphic support, and compressed bitmapped graphics—important improvements over the old PCL.

Until the release of PCL 5, LaserJets relied on bitmapped fonts. This meant that for every different size of type you wanted, you needed to store the image of each individual character in every size—these were stored in ROM cartridges or as downloadable fonts on disk. PCL 5 now supports scaled fonts that use Intellifont technology developed by AGFA Compu-graphic. These fonts allow you to create fonts from 0.25 to 999.75 points—a range wide enough for nearly anyone's use. Keep in mind that at 720 points, the letter "A" would stand 10 inches tall.

Hewlett-Packard's PCL level 5 also permits more-flexible printing of fonts than ever before. Text can be printed in portrait or landscape modes, right-side up or upside down. It is also now possible to print characters with special effects, such as those filled with a pattern or printed in white on a black background.

IMPROVED SPEED, PERFORMANCE

Some of the fancy font effects are made possible by another new feature in the PCL 5 printer: vector graphics. The LaserJet III can interpret HPGL/2 commands, which is the language used by Hewlett-Packard pen plotters. Vector graphic information can be sent far more quickly than bitmapped graphics, since the commands need only define the lines to be drawn, as opposed to describing each individual dot to be printed to create those lines. This feature also makes other effects possible. Rotatable fonts are but one

example; by converting text to vector images, the letters can be printed at any angle.

PCL 5 has attributes that can speed bitmapped graphics performance as well. The language supports three different data compression algorithms—TIFF, byte run-length encoding, and delta row—all three of which can shrink the amount of data required by the printer in order to transmit graphics images and speed up graphics-printing performance.

While HP points out that most major software vendors had LaserJet III PCL 5 drivers ready to ship at the time the printer was released, it will still be some time before most programs can take full advantage of these new features. Since the language is compatible with prior versions of PCL, LaserJet Series II drivers will work until PCL 5 versions are ready. By early 1991, other vendors should have moved up to PCL 5. Already, HP and Pacific Data Products have released scalable font cartridges to use with the PCL 5 technology in the LaserJet III.

The new features in PCL 5 eliminate most of the major differences between PCL and Adobe PostScript capabilities (though the two still are quite different and cannot share fonts), which should make LaserJet printers more attractive to many users. At the same time, PostScript printer prices have dropped dramatically, which reduces the savings offered by the LaserJets.

Nevertheless, you needn't be daunted by the vast range of choices. Choose your printer based on your applications and your budget—in the ever-ferocious printer wars, your dollar will bring you more value than ever before. ■

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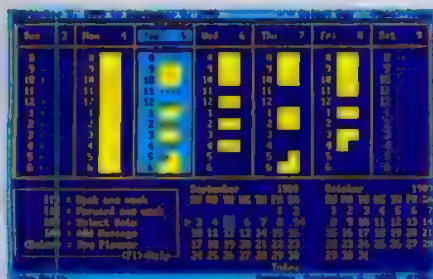
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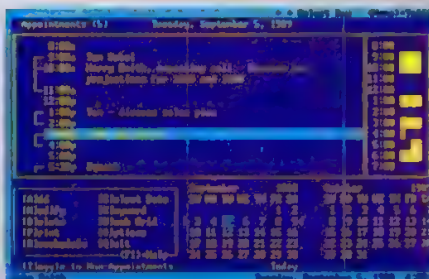
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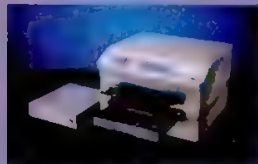
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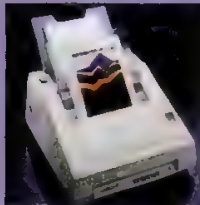
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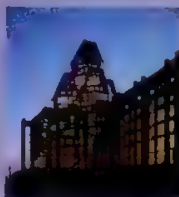
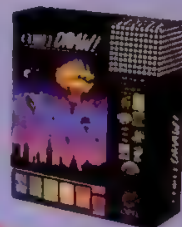
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FONTS & FEATURES				
IBM LaserPrinter E				
HP LaserJet Series II				
	Helvetica	Times	Courier	Line Printer
	Underline	Sub Super	Underline	Sub Super
	Italic	Italic	Italic	Italic
	Bold	Bold	Bold	Bold
8/9-point				
10-point				
12-point				
14-point				
Scalable				
IBM PPDS				
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

an impressive \$329 envelope feeder option which utilizes the solid design of the LaserPrinter E's paper path to provide remarkably dependable performance.

All the user controls are easily accessible on the front of the unit. One disadvantage of the user-control display, however, is its cryptic single-digit LED message display. While the other features are easy to understand, a simple paper jam will send you searching through your manual to look up error codes. An LCD message display—as found on other printers in the same price range—would make understanding what this printer is trying to tell you more convenient.

Street-priced at under \$1,000, the LaserPrinter E's features and upgrade possibilities make it the choice selection in the inexpensive personal laser market. IBM has shown its commitment to quality with this printer, and may well have succeeded in beating Hewlett-Packard at its own game.

Kyocera F-1800A

by John R. Quain

In order to achieve exceptional results, one often has to break with convention. More than a few users will find the design of the \$4,995 Kyocera F-1800A a bit iconoclastic, but they will also find its speed and flexibility impressive.

At the top of Kyocera's line, the F-1800A employs Kyocera's own LED array engine and a 68020 processor to kick out 18 ppm. Rated for 30,000 copies a month and offering seven emulations (including LaserJet Series II, IBM Proprinter, and Epson FX), this machine delivers fast,

PRINTERS LASERS

pleasing 300-dpi printing at a reasonable price. But output isn't the F-1800A's problem; it's what goes into the machine that may cause a few users to shy away.

The F-1800A uses a three-part setup: developer cartridge, toner kit, and drum cartridge. And if the words "tonerkit" haven't already sent you screaming for stain remover, you'll be relieved to hear that setting up the Kyocera takes only about 30 minutes, even including shaking the toner and scrupulously reading the instructions for the photoconductor drum installation.

The separate consumables are included with the printer, but replacing them will cost you more than just installation time.

FONTS & FEATURES				
Kyocera F-1800A				
HP LaserJet Plus				
	Helvetica	Times	Courier	Line Printer
	Underline	Sub Super	Underline	Sub Super
	Italic	Italic	Italic	Italic
	Bold	Bold	Bold	Bold
8/9-point				
10-point				
12-point				
14-point				
Scalable				
IBM Proprinter				
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

The toner kit is \$41 and lasts for about 4,000 pages. The developer cartridge is rated for 50,000 pages and will set you back \$170, while the photoconductor cartridge has a 12,000-page lifespan and costs \$180 to replace.

A membrane control panel contains self-explanatory buttons for status, page output, on-line and manual feed switching, page orientation, form feed, and setting additional parameters, such as the emulation mode and the number of copies. A two-line LCD display proved difficult to read at various angles, but it conveyed easily understood messages.

On the backside of the F-1800A, there's a Centronics parallel port and an RS-232C serial port. Both ports are active simultaneously to deal with networked users. You can increase the 1MB buffer size to a maximum of 5MB for \$1,980 for network applications.

If you plan to use the F-1800A for such applications, its supplied 250-sheet cassette may not be enough for your needs. Kyocera sells an otherwise identical laser—the \$6,995 F-3000A—which provides two cassettes. But a better value is to get the F-1800A and its optional \$895 1,000-sheet bin feeder. The extra cassette comes with a pedestal, and increases the machine's height to 18 inches and width to 41 inches when using the faster straight-through path (you can use a tighter C-path by merely throwing a lever).

To accommodate as many users as possible, the F-1800A offers a wealth of emulations: HP LaserJet Series II, IBM Proprinter, Epson FX, Diablo 630, NEC Spinwriter, Qume Sprint II, and a Line Printer mode. We found no problems in any of the modes we tested. The F-1800A flew through our PCL torture test without missing a beat, perfectly matching the HP output, save for the high order ASCII character set, which required an additional control code.

Running the PC Labs speed tests under the LaserJet Series II emulation, however, did uncover a couple of quirks. The



Kyocera F-1800A

Kyocera Unison Inc., 1321 Harbor Bay Pkwy., Alameda, CA 94501; (800) 367-7437, (415) 748-6680.

List Price: \$4,995; upgrade to 2MB RAM, \$595; upgrade to 3MB, \$1,090; upgrade to 4MB, \$1,585; upgrade to 5MB, \$2,085; font cards, \$205 each; optional paper-bin feeder, \$895; optional legal cassette, \$79.

Standard Warranty: 90 days on parts and labor.

Dimensions (HWD): 13 x 34 x 18 in.

Weight: 57.4 lbs.

Emulations: HP LaserJet Series II, IBM Proprinter, Epson FX, Diablo 630, NEC Spinwriter, Qume Sprint II, Line Printer.

In Short: The F-1800A offers tremendous flexibility with seven emulations, clean output at one of the highest speeds in this roundup, and a reasonable price. A downside is the tricky toner kit, which will cost you time initially and some money over the long haul.

CIRCLE 411 ON READER SERVICE CARD

F-1800A's performance on our graphics speed test alternated between 2.4 and 2.8 gppm, depending on whether or not we started from a dead stop. A Kyocera spokesperson explained that, after sitting idle for more than 20 seconds, the printer remixes its dual-component toner. But despite the slight delay, the printer's output was good looking and smudge-free, as the company promised.

The Kyocera also hit a minor snag on our text speed tests: The F-1800A refused to print out a blank page between tests. The company spokesperson explained that the printer will not output a blank page when fed the ASCII 20 form-feed command used by our test. During testing, this

An additional connector on the Mannesmann Tally 906 makes this printer the only TEC engine-based laser with a dual-bin facility.

presented a minor inconvenience that was easily overcome. But in the real world, this may even be an advantage because it means wasting less paper. Moreover, after adapting our tests, we coaxed the F-1800A to churn out 15.2 ppm, one of the fastest numbers among this year's harvest of page printers.

In addition to speed and sharp output, the F-1800A offers a number of features including automatic bar codes, 79 resident fonts, and three scalable fonts. If you're a font fanatic, additional plug-in cards are available for \$325 each (there are two IC slots on the front of the machine). Also standard is Kyocera's *Prescribe*, which allows you to circumvent some of the more arcane control codes no matter what emulation you're in and use *Prescribe*'s straightforward commands to access such features as dynamic fonts, bar codes, and vector graphics.

For all its little quirks and eccentricities, after putting the F-1800A through its paces, we began to feel some affection for this loner. If you're not afraid to deal with something a little different, the Kyocera printer has a lot to offer in terms of speed, flexibility, and attractive output.

Mannesmann Tally 906 Mannesmann Tally 906PS by Matthew J. Ross

Mannesmann Tally continues the German tradition of premium performance at a premium price. Its 6-ppm 906, based on the Tokyo Electronics Corp. engine, demonstrates the company's engineering strength. Mannesmann Tally squeezes extra performance out of the TEC engine—for a price. The clamshell-designed 906 has a footprint of 8 by 24.3 by 14.8 inches, and weighs 35 lbs. In its base 512K LaserJet Series II emulation the 906 sells for \$2,195. The Bauer PostScript interpreter and 2MB memory upgrade raises the price to \$3,495, with discounts reaching as high as 33 percent available to good hagglers, according to the manufacturer.

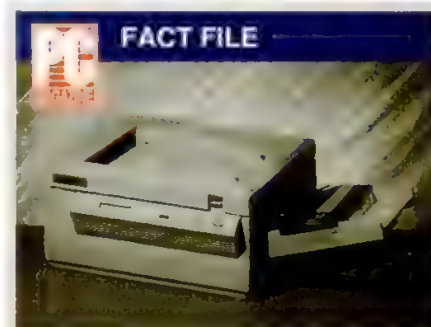
The TEC engine has become almost as common as that of the Canon SX in the laser market. It separates the drum unit, toner cartridge, and developing unit to reduce costs, but this design makes installation more difficult than Canon's one-piece cartridge assembly, and leaves the organic photoconductor drum exposed, increasing the chance of damaging the unit. Output can be either straight-through and faceup for heavier stock paper, or face-down and collated in a "C" path to the top paper tray.

The 906 features a standard 16-character liquid crystal display with a four-button control to cycle through the embedded menu of printer and font choices. The PCL 4 LaserJet Series II emulation is the unit's native mode, except when upgraded to the 906PS, whereby the native mode is PostScript. This option is either user- or dealer-installable. Courier, Courier Bold, and Line Printer are the resident fonts in both portrait and landscape mode, with the 906PS option adding Bitstream's version of the standard set of 35 Type 1 typefaces.

Adding the 2MB RAM plus PostScript emulation also permits support of the optional AppleTalk interface, in addition to the RS-232 and Centronics parallel connectors that come standard. An additional connector at the back of the 906 supports Mannesmann Tally's \$350 dual-

bin paper cassette option for both letter- and legal-size pages. This option makes the 906 the only TEC engine-based laser with a dual-bin facility. The standard tray holds 150 sheets, but the dual cassettes hold 250 pages each—this is an impressive if perhaps overdone feature for a 6-ppm printer, but a definite plus for connected environments. Other options include 1MB, 2MB, and 4MB memory upgrades.

While the majority of the Tokyo Electronics Corp. engine-based lasers feature the TEC 305 controller with the generic 10-MHz Motorola 68000 processor, Mannesmann Tally designed its own controller, using National Semiconductor's NS32C16 processor designed specifically for laser printers. Mannesmann Tally's JADE controller and custom ASIC push the TEC engine beyond its rated speed of 6 ppm, achieving a score of 6.1 ppm in its standard LaserJet Series II emulation, with graphics results being a respectable 1.8 gppm. Tested with the Microsoft/Bauer PostScript emulation



Mannesmann Tally 906
Mannesmann Tally 906PS
Mannesmann Tally Corp., 8301 S. 180th St., Kent, WA 98032; (800) 843-1347, (206) 251-5524.
List Price: \$2,195 (906); \$3,495 (906PS); upgrade to 1.5MB RAM, \$450; upgrade to 2.5MB, \$850; upgrade to 4.5MB, \$1,550; upgrade to 2.5MB plus PostScript emulator, \$1,450; upgrade to 4.5MB plus PostScript emulator, \$2,250; font cartridges, \$185 each; emulation cartridge, \$250; optional faceup output tray (for 906PS and 906), \$35; dual-cassette paper-feed attachment (for 906PS and 906), \$395, optional legal-paper cassette or 50-envelope cassette for the dual-bin option, \$55.
Standard Warranty: One year on parts and labor plus 90 days on-site.
Dimensions (HWD): 8 x 24.3 x 14.8 in. (both units).
Weight: 35 lbs. (both units).
Emulations: PostScript emulator, HP LaserJet Series II.
In Short: Mannesmann Tally squeezes premium performance at a premium price from its PostScript-capable 906PS. A dual-bin option distinguishes this laser from other TEC engine-based units.

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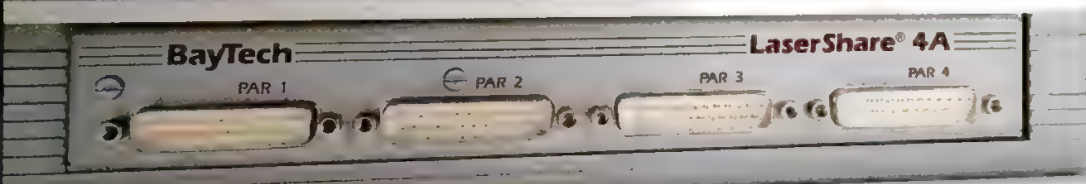
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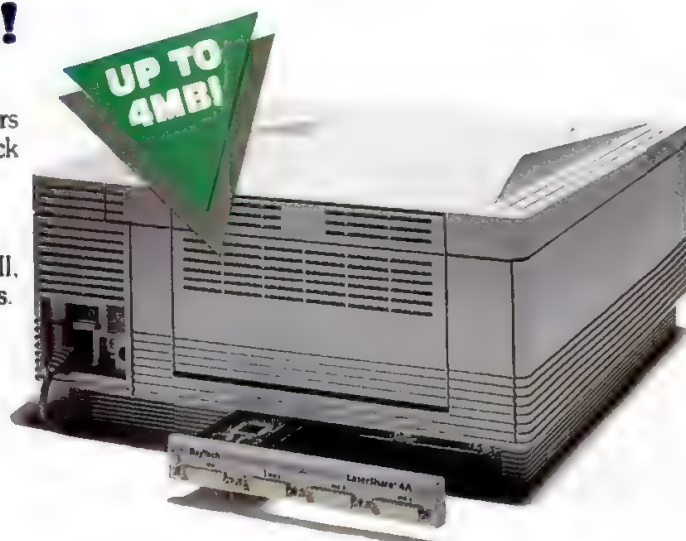
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FONTS & FEATURES

Mannesman Tally 906PS

PostScript emulator															
Helvetica				Times				Courier				Line Printer			
Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															

HP LaserJet Series II															
Helvetica				Times				Courier				Line Printer			
Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															

option, complete with 2.5MB of printer memory and the National Semiconductor NS32081 floating point unit, the 906PS chugged out 5.76 pages per minute on our text speed test, faster than the LaserJet Series II emulation of the Toshiba PageLaser6 and Facit P6060 lasers reviewed in *PC Magazine's* June 12, 1990 roundup, "A \$1,000 Laser for Every Desktop." The 906PS produced reasonable graphical performance under PostScript: 0.3 gppm.

As far as the output is concerned, the scanned photo image and grayscale bars were a bit dark and lacked some of the definition achieved by the HP LaserJet IIP, but the Bauer PostScript emulation demonstrated excellent performance producing good contrast and definition. Text output was as good as that of the competition. The 906PS's 35 Bitstream typefaces closely approximate the standard set of Adobe Type 1 fonts. As a PostScript clone, the 906PS accepts all Type 3 fonts, but Mannesmann Tally will not guarantee that Type 1 downloadable fonts will be compatible.

The 906 and 906PS are definitely solid performers, and the ability to upgrade yourself to PostScript emulation is attractive. However, Mannesmann Tally's prices rest at the higher end of the spectrum. For these prices, you can get true Adobe PostScript from vendors such as NEC. But if the combination of a TEC engine, fast processor, dual-bin paper feed, and a clone PostScript upgrade sound appealing, give Mannesmann Tally a second look.

Mitek 130T

by John R. Quain

If you've ever wondered about government spending, Mitek Systems' 130T, an \$8,995 8-ppm PostScript laser printer, may be a small indication of where our tax dollars are going. Mitek specializes in Tempest peripherals for the government (and government contractors), and the 130T is the company's Tempest version of the eminently reliable QMS PS-810 PostScript printer (also reviewed in this issue)—for nearly twice the price.

The Tempest rating is established by the U.S. government for security related products. Mitek shields the power and controller signals on the 130T to filter out stray RF signals emanating from the machine, signals that could be used in electronic eavesdropping. Rather than shielding the individual boards, Mitek places the components in a special enclosure. According to the company, the 130T meets the Tempest requirements and is on the government's EPTL (Endorsed Tempest Products List).

Most users, however, will feel the secrecy issue is a tempest in a teapot, so aside from the shielding, what does Mitek add? Well, about 10 pounds and a couple of extra inches in height. But then again there's not a lot to improve on the QMS machine, which was one of the first PostScript printers on the market. It uses the small-footprint Canon SX engine and its

FONTS & FEATURES

Mitek 130T

PostScript															
Helvetica				Times				Courier				Line Printer			
Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															

HP LaserJet Plus															
Helvetica				Times				Courier				Line Printer			
Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															

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CIRCLE 120 ON READER SERVICE CARD



Mitek 130T

Mitek Systems Inc., 6225 Nancy Ridge Dr., San Diego, CA 92121; (800) 367-5660, (703) 834-6600.

List Price: \$8,995; upgrade to 3MB RAM, \$995; optional envelope cassette attachment, \$90.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 10.5 x 18 x 24.8 in. **Weight:** 60 lbs.

Emulations: PostScript, HP LaserJet Plus, HPGL, Diablo 630.

In Short: A Tempest version of the QMS-PS 810, the 130T's steep price and its trouble with HP emulation will dissuade all but the most security conscious from buying.

CIRCLE 413 ON READER SERVICE CARD

in at 7.5 ppm, as expected.

Tests in the HP emulation turned in similarly predictable numbers. Graphics speed was 1.3 gppm, and the output was virtually indistinguishable from actual HP output. Text speed was 7.4 ppm.

When it came to PC Labs' PCL torture test, the 130T failed to kick out even the first page intact. To a lesser extent, we encountered the same problem with the QMS PS-810 and PS-820 test units, even though the software version number in their controllers was more recent than the one in the Mitek unit. QMS confirmed our findings, explaining that the company is working with Adobe to solve the problem in a future release. However, neither Mitek nor QMS could explain why the controller in the 130T test unit was out of date.

If you're looking for a reliable PostScript laser printer, you shouldn't find the HP emulation problems all that disturbing. The Mitek 130T is a fine QMS PS-810 PostScript laser printer. What you may find disturbing is the nearly \$9,000 price tag. No matter how privacy-threatening the new Supreme Court may seem, you have to ask yourself whether it's worth nearly double the money to protect your data stream. On the other hand, if your machine has to have Tempest protection, your choices are limited.

NCR 6436-0501

by David Dean

The \$9,450 NCR 6436-0501 printer is the spitting image of an old timer, the Texas Instruments OmniLaser 2115 (reviewed in our November 10, 1987, Printer Blockbuster). These twins are both based on the Ricoh 4150 laser print engine, housing, and paper handling mechanisms. Although both are PostScript-compatible (the TI printer has true Adobe PostScript; the NCR has an in-house PostScript clone) and come with a standard 3MB of memory on board, NCR is betting that its speedy firmware, dual-functioning ports, and SCSI port option are going to draw the eyes of Texas toward Wichita, Kansas.

The NCR 6436 sprints past the OmniLaser 2115 in printer-sharing situations by allowing you to use both the serial and parallel ports simultaneously. These two ports can be independently configured to any of the seven available emulations

from the front panel or by downloading the proper escape codes.

Separate jobs from both sources are jogged to the right and left of the output tray, creating two separate collated piles. Like the OmniLaser 2115, the NCR 6436 feeds paper from both of its 250-sheet paper trays through a C-shaped paper path. It has no manual paper feed for straight through printing, and cannot feed paper over 24 pounds without curling. The NCR 6436 paper trays can accommodate A4-, letter-, and legal-size paper.

The NCR 6436-0501's serial port, which can also be configured as an AppleTalk port, has a maximum speed of 38,400 bps—lower than the OmniLaser's 57,600-bps rating. Another version of this printer, the NCR 6436-0301, offers a SCSI port, but does not have a PostScript emulation. It lists for \$7,995.

All of our speed tests were done using the parallel port of the 6436-0501. At nearly 4 ppm, the NCR printer's PostScript emulation performed admirably on our text speed test; the LaserJet Series II emulation came closest to matching the Ricoh engine's 15 ppm rating at 13 ppm. Our other tests of the LaserJet emulation were not as rosy.

We had to do quite a bit of homework to get Courier Bold output for our font test because the NCR 6436 uses a non-standard escape code. Another stumbling block: The NCR 6436 would not switch to a landscape page during our tests; and one of our tests downloaded a LaserJet font to the printer and then, following a hard command to switch back, the NCR 6436

FONTS & FEATURES

NCR 6436-0501

PostScript emulator

	Helvetica	Times	Courier	Line Printer
	Underline Sub Super Italic Bold	Underline Sub Super Italic Bold	Underline Sub Super Italic Bold	Underline Sub Super Italic Bold
8/9-point				
10-point				
12-point				
14-point				
Scalable				

HP LaserJet Series II

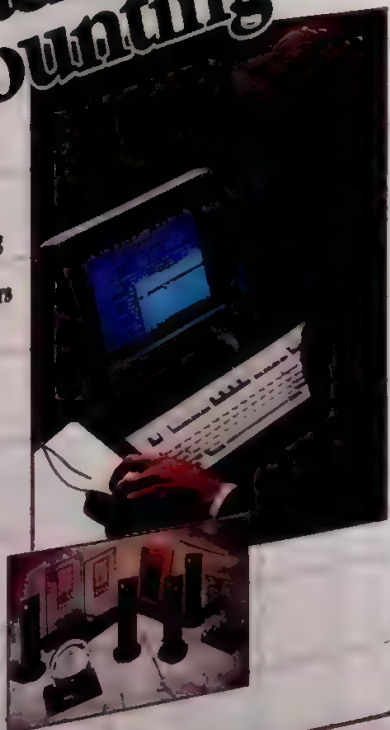
	Helvetica	Times	Courier	Line Printer
	Underline Sub Super Italic Bold	Underline Sub Super Italic Bold	Underline Sub Super Italic Bold	Underline Sub Super Italic Bold
8/9-point				
10-point				
12-point				
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Scalable				

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SEE US AT FALL COMDEX AT THE SANDS

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HOW TO TRANSFORM YOUR LASERJET INTO A HIGH-FLYING POSTSCRIPT MACHINE

Adding PostScript to your LaserJet is as easy as plugging in a cartridge, or adding an expansion board, or installing software. And it's affordable, with prices starting as low as \$99 for a software PostScript clone.

by Edward Mendelson

Never underestimate the flexibility of a LaserJet. If you aren't satisfied with Hewlett-Packard's tried-and-true workhorse, you can transform it into a thoroughbred PostScript printer. The transformation won't cost much, and can give you output that's better than anything you can get from Apple's slow and expensive PostScript printers. Best of all, you can still use your machine as an ordinary LaserJet when you don't need PostScript.

You can add PostScript to a LaserJet in three different ways. Physically, by plugging in a cartridge or by adding an expansion board to your computer and connecting it to the LaserJet via a cable; or, lastly, leave the printer untouched and print PostScript files using software that translates PostScript into the LaserJet's native language. The LaserJet Series II, IID, III, and IIID can use all three methods. The IIP, however, can't use an expansion board. All three methods work with any application that has a PostScript driver.

CARTRIDGES

Plug-in cartridges are by far the simplest alternative. They let you tell your applications you have a PostScript printer, and print without any fuss. Cartridges are relatively cheap, but you may need to add 1MB or 2MB of RAM to the printer's memory before use.

If you want Adobe PostScript rather than a clone, the \$695 Hewlett-Packard LaserJet PostScript Cartridge is the only way to add it to a LaserJet IIP, IID, III, or IIID; the \$495 Adobe PostScript Cartridge is the best way to add it to a Series II. All current cartridges, whether they use Adobe or a clone, can print Adobe's Type 1 soft fonts, although with differing levels of quality.

The controller in the LaserJet Series II is designed differently from the controllers in later printers like the IID, IIP, and III. So any PostScript cartridge that works in the later printers won't work in the Series II, and vice versa. Most cartridge vendors sell two different models, one for the LaserJet Series II and some compatibles, one for later HP printers. HP sells an Adobe-licensed cartridge for the later HP printers only, and Adobe sells its own cartridge specifically for the Series II.

For the fastest and highest-quality output you can get from a cartridge, plug Hewlett-Packard's unit into a LaserJet III or IIID. HP uses Adobe Type Manager font-rendering technology for exceptionally fast and sharp text at small sizes, and the Resolution Enhancement technology built into the III and IIID improves the clarity of all text and graphics. In a LaserJet III, the HP cartridge performed at an impressive 7.4 pages per minute in PC Labs' text speed test and a reasonable 0.4 graphics pages per minute in the graphics speed test. You get similar output, without the extra clarity of Resolution Enhancement, when you plug the cartridge into a LaserJet IIP or IID, or when you use Adobe's PostScript cartridge into a Series II.

The Adobe cartridge for the Series II prints text at 7 ppm and graphics at 0.4 gppm, and includes software to create screen fonts in *Windows* and *Ventura*. Adobe has also released two \$395 PostScript font cartridges for use only with the LaserJet Series II/Adobe PostScript cartridge combination.

Pacific Data's \$495 PacificPage cartridge runs slower than the HP and Adobe models but has some typographic advantages. Its built-in Bitstream fonts look better than Adobe/HP versions in

all except small sizes, where Adobe and HP create better-spaced, better-shaped type. The *PhoenixPage* interpreter in the cartridge prints Type 1 soft fonts less smoothly than Adobe or HP, but, unlike other PostScript cartridges and software, can also print special soft fonts created by Bitstream's *Fontware*. In PC Labs' tests PacificPage printed text at 3.7 ppm and, apparently because of a compatibility problem, failed to print the graphics test at all. With other mainstream applications it prints at about two-thirds the speed of the HP model.

Two other cartridges, PCPI's \$349 ImageScript and Computer Peripherals' \$495 JetPage, are lesser performers. Their built-in fonts are crude URW designs, and when they print Adobe Type 1 soft fonts, the output is unacceptably thick and rough-edged. The ImageScript adds 12 extra built-in fonts to the standard PostScript 35. Both cartridges printed text at 2.6 ppm and graphics at 0.1 gppm in PC Labs' tests. The vendors won't name the clone interpreter built into these cartridges, but their output is strikingly similar to what you get with the *Freedom of Press* software interpreter.

SOFTWARE

Four packages let you print PostScript files from any application without adding hardware to your printer, although all produce better results if you add RAM to your computer. If you have enough extended memory, two of these packages, *UltraScript PC* and *PreScript*, will load as TSRs, and let you print directly from your applications. These packages also let you print to a file and then send the file to the printer in a separate operation. The other two

CONTINUES

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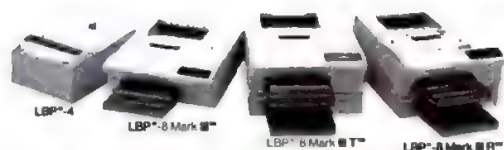


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ADD-ONS

CONTINUED

packages, *Freedom of Press* and *GoScript Plus*, only let you print in a separate operation after printing to a file.

QMS' *UltraScript PC* (\$195 with 25 fonts, \$445 for the *UltraScript Plus* version with 47) produces the finest output of the packages reviewed. It comes with excellent fonts, and you can get more from QMS, although Type 1 fonts aren't supported. As with all these packages, the speed of your computer, not of your printer, has the most effect on the print speed, so PC Labs' speed tests won't indicate the performance speed of your machine. If you install *UltraScript PC* on a 33-MHz 80386 machine, it prints at about the same speed as the HP cartridge; slower machines lag behind.

Pan Overseas Computer's *PreScript* (\$395 with 50 fonts, \$195 with 28) includes a nifty *Windows* preview mode that shows what will print before you see it on the page, but that's its major advantage. Although its print speed is comparable to *UltraScript's* it comes with notably clunky fonts, and it also doesn't support the Type 1 format.

Custom Applications' \$495 *Freedom of Press* handles Type 1 fonts, although the output from these fonts is thicker and coarser than it should be, and the 35 fonts supplied by URW have little appeal. *Freedom of Press* installs easily, and runs from convenient batch files, but its processing speed is about half the speed of its rivals.

LaserGo's \$99 *GoScript Select* is by far the least expensive route to LaserJet PostScript. It prints at a slightly faster speed than *UltraScript*, but like *Freedom of Press*, uses crude URW fonts. It's convenient to use, but you'll have to write batch files to make it as handy as *Freedom of Press*.

ADD-IN BOARDS

With the advent of PostScript cartridges, most PostScript add-in boards are obsolete. The 300-dot-per-inch models tend to be expensive, complicated to install, take up a slot in your CPU, and make you load software—and slowly at that—before you can use them. (For a survey of these boards, see "Post-Purchase PostScript," April 11, 1989.) The older 300-dpi boards can't match the

output from the latest cartridges, although a new 300-dpi model, the \$1,995 Q-Script from Bell & Howell Quintar (Torrance, California, (213) 320-5700), uses the excellent *PhoenixPage* interpreter.

Yet unlike cartridges and software, some newer add-in boards can extend the resolution of the 300-dpi LaserJet to as much as 600 dpi. When *PC Magazine* reviewed these high-resolution boards (see "High-Resolution Printer Boards," April 24, 1990), the best was the \$1,195 LaserPort PS 600 from DP-Tek (Wichita, Kansas, (800) 727-3130), which uses *UltraScript* software to print at a full 600 dpi.

Whichever method you decide on, it's time to get PostScript for your LaserJet. A great printer deserves nothing less.

A non-PostScript P.S.: If you're looking for ways to enhance the typography or gray-scale output of your LaserJet, you'll find some still-useful tips in "How to Get the Most Out of Your Laser Printer" (November 14, 1989). Since that issue appeared, HP and Pacific Data Products have released scalable font cartridges for use with the PCL 5 in the LaserJet III.

HP LaserJet PostScript Cartridge

Hewlett-Packard Co., Inquiries, 19310 Pruneridge Ave., Cupertino, CA 95014; (800) 752-0900.

List Price: \$695.

Requires: LaserJet IIP or III, with 1MB additional RAM; LaserJet IID with 2MB additional RAM.

In Short: Superb Adobe PostScript output at high speed.

CIRCLE 602 ON READER SERVICE CARD

PostScript Cartridge

Adobe Systems, Inc., 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039; (415) 961-4400.

List Price: \$495.

Requires: LaserJet Series II with 1MB additional RAM.

In Short: Superb output at the fastest speed possible with the LaserJet Series II.

CIRCLE 603 ON READER SERVICE CARD

PacificPage

Pacific Data Products, 9125 Rehco Rd., San Diego, CA 92121; (619) 552-0880.

List Price: \$495.

Requires: LaserJet Series II or later with 1.5MB RAM.

In Short: Excellent Bitstream fonts and Type 1 support make this the best alternative to HP or Adobe's cartridge.

CIRCLE 604 ON READER SERVICE CARD

ImageScript

ImageSoft, 2 Haven Ave., Port Washington, NY 11050; (800) 245-8840.

List Price: \$349.

Requires: LaserJet Series II or later with 1.5MB RAM.

In Short: A slow-printing cartridge with crude URW fonts, but with 12 more than the standard 35 fonts.

CIRCLE 605 ON READER SERVICE CARD

JetPage

Computer Peripherals Inc., 667 Rancho Conejo Blvd., Newbury Park, CA 91320; (800) 854-7600, (805) 499-5751.

List Price: \$495.

Requires: LaserJet Series II or later with 1.5MB RAM.

In Short: A slow-printing cartridge with crude URW fonts.

CIRCLE 606 ON READER SERVICE CARD

UltraScript PC Plus

QMS Inc., 1 Magnum Pass, Mobile, AL 36608; (800) 631-2692, (205) 633-4300.

List Price: \$195 (25 fonts); *Plus* version, \$445 (47 fonts).

Requires: 80286 or higher CPU with 1.5MB RAM; most standard dot-matrix, ink jet, or laser printers.

In Short: Excellent fonts and fast output from this software emulator; no support for Type 1 fonts.

CIRCLE 607 ON READER SERVICE CARD

PreScript

Pan Overseas Computer, 1144 West Olympic, Suite 1010, Los Angeles, CA 90064; (213) 312-9562.

List Price: \$395 (with 50 fonts); \$195 (28 fonts).

Requires: 80286 or higher CPU with 1MB extended RAM; any HP-compatible printer.

In Short: Fast printing from within applications and a preview mode for *Windows*, but uses remarkably crude fonts.

CIRCLE 608 ON READER SERVICE CARD

Freedom of Press

Custom Applications Inc., 900 Technology Park Dr., Building 8, Billerica, MA 01821; (508) 667-8585.

List Price: \$495.

Requires: Virtually any dot-matrix, laser, or ink jet printer; 640K RAM on CPU.

In Short: Easy installation, but crude URW fonts give unappealing output.

CIRCLE 609 ON READER SERVICE CARD

GoScript Select

LaserGo Inc., 9369 Carroll Park Dr., Suite A, San Diego, CA 92121; (800) 955-1132, (619) 450-4600.

List Price: \$99.

Requires: 640K RAM on CPU; HP-compatible laser printer or DeskJet; *GoScript Plus*, \$299 (adds dot matrix and other ink jet support).

In Short: The cheapest and fastest PostScript interpreter, but uses crude URW fonts.

CIRCLE 610 ON READER SERVICE CARD



FACT FILE

NCR 6436-0501

NCR Corp., 3718 N. Rock Rd., Wichita, KS 67226; (316) 636-8570.

List Price: \$9,450; upgrade to 4MB RAM, \$995; optional A4, legal or letter tray, \$35.

Standard Warranty: 90 days on parts and labor.

Dimensions (HWD): 14.3 x 21 x 28.3 in. **Weight:** 88 lbs.

Emulations: PostScript emulator, HP LaserJet Series II, HPGL, IBM Proprinter, Epson FX, Diablo 630, Line Printer.

In Short: Aimed at the heavy demands of a printer-sharing environment, the 6436-0501 includes seven scalable printer emulations, simultaneously active serial and parallel ports, paper jogging, and a PostScript emulation. Expensive, but worth a look for heavy-duty users.

CIRCLE 416 ON READER SERVICE CARD

wouldn't revert to the Courier default setting.

The NCR 6436 printed our PostScript graphic file at about twice the speed of the Apple LaserWriter NTX with commendable quality, although the LaserJet graphics are less acceptable. As with most laser printers, the 6436 fills black areas solidly. However, there is often a gray tinge to the page and fuzziness encroaches on detailed graphics and can fill in text. (For more information on "white-writer" laser printers, see the sidebar "Paper for Page Printers" in the November 14, 1989 Printer Blockbuster.)

The front panel's 16-character LCD readout is easy to navigate. It offers 11 LED status lights above the LCD window, and two more LEDs next to the paper tray selection membrane button to show which tray is active. There is a Shift button which doubles the options available from the five other buttons. Below the front panel are two font cartridge slots that require NCR proprietary font cartridges.

The limited font cartridge options are readily made up by the 35 scalable default PostScript fonts available in the NCR

PRINTERS

LASERS

6436's PostScript emulation mode. You can also scale the typefaces available via the other six emulations, for example 10-point Courier or 11-point Line Printer in the LaserJet Series II emulation. The printer will also cache downloaded LaserJet soft fonts. The NCR PostScript emulation accepts downloaded Type 3 typefaces, but not the recently published Adobe Type 1 format.

The NCR 6436 expresses paper in its LaserJet mode. And, while the LaserJet emulation choked on some of our tests, all of the problems are correctable—usually from the front panel. Also, as LaserJet PostScript cartridges proliferate and bog down more and more 8-ppm printers, the NCR 6436 gives you access to PostScript graphics and scalable fonts in a hurry. Dual functioning interfaces combined with a job sorter make this printer a good candidate for printer sharing, especially in network situations.

NEC Silentwriter2 90

by Alfred Poor

It's little, it's fast, it's new. And it's going to shake up the PostScript printer market. The NEC Silentwriter2 90 is a 6-ppm printer with 2MB of memory and true Adobe PostScript (as well as an HP LaserJet emulation) at a stunning list price of just \$2,495.

Most "personal lasers" are assembled around the new generation of 4-ppm print engines. NEC went for a competitive edge by using a 6-ppm engine from Minolta, which gives it a 50 percent speed advantage over the slower designs. The print generally looks a lot like a Canon design, using a one-piece toner and drum cartridge for ease of handling. One big difference between the Minolta and Canon engines, however, is the cartridge life: While the Canon LX engine cartridge is rated at 3,500 pages, NEC's Minolta engine claims a whopping 8,000 pages per cartridge.

The print quality of the new engine is excellent. The blacks are smooth and solid, the lines are crisp, and there are no obvious problems in the output.

A faster engine does not necessarily make for a faster or better printer, but NEC has made the most of this solid

FONTS & FEATURES

NEC Silentwriter2 90

PostScript

	Helvetica	Times	Courier	Line Printer
	Underline	Underline	Underline	Underline
	Sub Super	Sub Super	Sub Super	Sub Super
	Italic Bold	Italic Bold	Italic Bold	Italic Bold
8 9/16-point				
10-point				
12-point				
14-point				
Scalable				

HP LaserJet Series II

	Helvetica	Times	Courier	Line Printer
	Underline	Underline	Underline	Underline
	Sub Super	Sub Super	Sub Super	Sub Super
	Italic Bold	Italic Bold	Italic Bold	Italic Bold
8 9/16-point				
10-point				
12-point				
14-point				
Scalable				

foundation. The printer uses Adobe PostScript, Version 52.2, and comes with a full complement of 35 font outlines in ROM. If you need more memory for downloaded outlines, you can add a second 2MB of memory for a list price of \$995.

Not only do you get PostScript, but you also get HP LaserJet IIP emulation. The performance on our PCL test was flawless: The Silentwriter2 90 handled even



FACT FILE

EDITOR'S CHOICE

NEC Silentwriter2 90

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; (800) 632-4636, (508) 264-8000.

List Price: \$2,495; upgrade to 4MB RAM, \$995; downloadable fonts, \$200, optional faceup tray, \$139.

Standard Warranty: One year on parts and labor, 90 days on-site.

Dimensions (HWD): 8.4 x 18 x 24.6 in. **Weight:** 40.4 lbs.

Emulations: PostScript, HP LaserJet Series II.

In Short: With a 6-ppm engine, true Adobe PostScript in a fast controller, and plenty of extra features, the Silentwriter2 90 is able to compete with full-size laser printers. Its low list price represents an excellent value.

CIRCLE 414 ON READER SERVICE CARD

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The '486 chip is a technological marvel.

It includes not only an advanced processor core but also a built-in cache controller, memory cache, floating point math coprocessor, and an advanced memory management unit. Running 40%-50% faster than similar '386 chips, the '486 makes short work of any processor-intensive applications. But where does it *really* shine?

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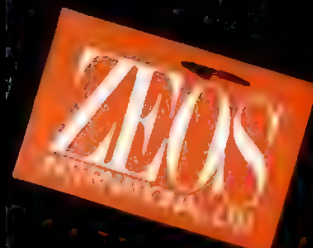
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the trickiest portions with aplomb. The printer includes the PC-8 symbol set so that you can access the line-drawing characters under HP emulation—a feature overlooked by some PostScript printers that emulate LaserJets. The only apparent shortcut is that NEC doesn't provide a true Line Printer font in HP emulation; as with its more expensive sibling, the NEC Silentwriter2 290, a small version of Courier is substituted.

Nevertheless, you needn't sacrifice speed for savings. The 90 churns out text at a respectable 5.8 ppm under PostScript and 5.5 ppm under its LaserJet emulation. When printing graphics under PostScript, however, the printer truly shines: Its 0.7-gppm output puts it among the fastest PostScript printers we tested this year—more than twice as fast as some of the 8-ppm machines.

The Silentwriter2 90 has a number of other attractive qualities. It comes with parallel, serial, and AppleTalk/RS-422 interfaces. Instead of the open bin found on many personal lasers, there is a real paper tray that accepts up to 250 sheets at a time—25 percent more than with a Canon SX engine. You get a full range of paper-path choices: faceup or facedown, tray or manual feed, and a nearly straight-through paper path available for heavier stock.

There's a lot to like about the NEC Silentwriter2 90. It's among the lowest-priced Adobe PostScript lasers and comes with the full complement of 35 fonts—including HP LaserJet IIP emulation with HP's PostScript cartridge—and it offers a 6-ppm engine instead of the usual 4-ppm version into the bargain. With the arrival of this machine, personal PostScript printing has suddenly become more affordable and more attractive.

NEC Silentwriter2 290

by Alfred Poor

The NEC Silentwriter series has long been popular with those seeking true PostScript printing at affordable prices. The new Silentwriter2 printers reveal some changes in the NEC designs, but the 8-ppm Silentwriter2 290 comes with a list price of \$3,995 and remains true to the spirit of the older models.

One important change is the choice of print engine. Older versions of the Silentwriter were based on NEC's own LED

PRINTERS LASERS

Fonts & Features NEC Silentwriter2 290

PostScript														
	Helvetica				Times				Courier				Line Printer	
	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super
8.9-point														
10-point														
12-point														
14-point														
Scalable														

HP LaserJet Plus														
	Helvetica				Times				Courier				Line Printer	
	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super
8.9-point														
10-point														
12-point														
14-point														
Scalable														

print engine. The Silentwriter2 290 takes a more conventional approach, relying on the new Canon SX laser engine.

The printer's squared-off lines and tapered base sections give the impression that it is standing on square columns at the four corners. It uses the same one-piece toner/drum cartridge and 200-sheet paper tray that others based on the Canon SX engine use. Manual feed, faceup or facedown output, and a straight-through paper path are standard. An envelope tray (\$89) is optional.

The control panel is located on the lower edge along one of the printer's long sides. While this improves the printer's appearance, it means that reading the LCD message window or the tiny button labels is more difficult when you are standing next to the printer than when sitting down—a small nuisance that detracts only slightly from the printer's appeal. On the positive side, the 16-character LCD window has a backlight, which is a rarity on laser printers.

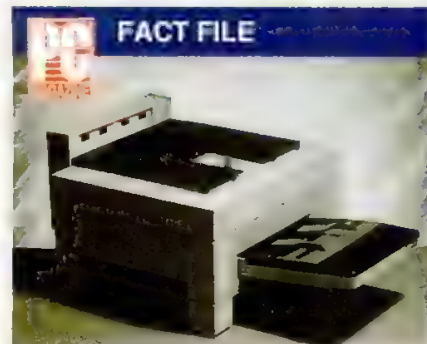
The controller contains 2MB of memory as a standard feature, expandable to 4MB for an additional \$995. The printer uses genuine Adobe PostScript, Version 52.0, and comes with a full complement of the standard 35 fonts. The Silentwriter2 290 also emulates an HP LaserJet Plus without error; in fact, it goes beyond the limits of the Plus by offering access to other fonts, including Courier Italic and Bold, which are not found on a standard LaserJet. On the other hand, the printer

does not support the PC-8 symbol set under LaserJet emulation, which means you do not get the PC line-drawing characters. Also, the printer substitutes a tiny Courier font for true Line Printer.

The Silentwriter2 290 is one of the fastest PostScript printers we tested this year. While its text speeds of 7.4 ppm in PostScript and 7.5 ppm in LaserJet mode are about what you'd expect from an 8-ppm engine, the PostScript graphics speed of 0.7 gppm is among the top five speeds.

You can hook up the Silentwriter2 290 to just about any micro on the market. It comes with parallel, serial, and AppleTalk/RS-422 connectors. The front-panel controls let you select ports and emulations with ease.

The biggest problem with the Silentwriter2 290 is its price. Adobe PostScript printers have been dropping in price this year, and you now have plenty of good options available. For example, an HP LaserJet III with extra memory and HP's Adobe PostScript cartridge costs a few hundred dollars less than the Silentwriter2 290, even if you add in HP's AppleTalk interface option. To be competitive, the Silentwriter2 290 would have to be deeply discounted on the street—if you can find it at a good price, or if you need the extra graphics speed it offers under PostScript, then it makes an excellent choice.



NEC Silentwriter2 290

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; (800) 632-4636, (508) 264-8000.

List Price: \$3,995; upgrade to 4MB RAM, \$995; downloadable fonts, \$200; optional legal feeder, \$79; envelope feeder, \$89.

Standard Warranty: One year on parts and labor, 90 days on-site.

Dimensions (HWD): 11.6 x 25.5 x 17.3 in.

Weight: 49 lbs.

Emulations: PostScript, HP LaserJet Plus.

In Short: The Silentwriter2 290 has speed and a host of features, but its relatively high list price makes it a less attractive value than some of the other 8-ppm printers in its class. Unless the street price is heavily discounted, you'll get more for your money elsewhere.

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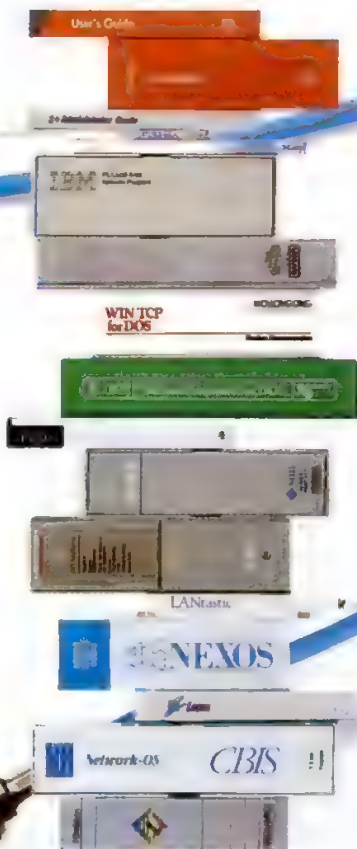
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THE LASERMASTER LM 1000: High Resolution at High Speed

by Bill O'Brien

In our printer roundups, LaserMaster is the perennial bridesmaid. Although the company's printers offer resolutions exceeding the 300- by 300-dot-per-inch standard, their usefulness in the PC marketplace is limited because they lack any standard emulation—such as HP LaserJet, PostScript, IBM Proprinter, IBM Graphics Printer, Epson, or even Diablo. Nevertheless, with consistently fast graphics at a whopping virtual 1,000- by 1,000-dpi, LaserMaster's latest offering, the \$7,495 LM 1000 Plain Paper Typesetter, is the closest thing to typeset-quality output a PC owner can find.

The new LM 1000 offers two improvements over the LaserMaster 1000 we reviewed in last year's issue (see "LaserMaster 1000: Typesetter-Quality 1,000 by 400 dpi," November 14, 1989). The new printer is capable of virtual 1,000- by 1,000-dpi, whereas the older model produced a vertical resolution of only 400 dpi. (LaserMaster also offered a printer that could achieve 800-dpi vertical resolution.) The other benefit is that it's one unit; last year's offering was made up of two separately priced parts.

The new system consists of three components: a 16-bit interface board in ISA or MCA versions, a printer, and the appropriate software. The printer is built around an 8-ppm Canon SX engine modified into a new functional configuration that LaserMaster has dubbed *TurboRes*. The result is control not only of the horizontal modulation of the laser beam but also the vertical incremental travel speed of the paper. This is what gives the LM 1000 its high resolution capability.

The interface board acts as an image-processing medium and font cache area. What would be the simple act of printing in a low-resolution system is converted, on the interface board, into a multitasking event. The initial im-



The new LaserMaster LM 1000 produces some of the best graphics we've ever seen. And it does so at impressive speeds. The catch is that, without a standard emulation, its usefulness is limited.

age, or "page," is accepted and stored in one *memory frame*—the memory segment reserved for processing the page. While this first page is being transmitted to the printer, the next page is being processed in another memory frame. According to LaserMaster, this alternate-frame methodology produces no delay in printing.

To achieve resolution virtually as high as 1,000- by 1,000-dpi, the LaserMaster uses a proprietary management scheme called Direct Display/Printer Interface (DDPI). In past years, the DDPI software has existed as a terminate and stay resident (TSR) program that intercepted the printed output from various programs. It occupied between 27K and 50K RAM. In computers with 80386-based or higher processors, DDPI could also be loaded into extended memory. But with most current software manipulating memory in new, unconventional ways, TSRs have become hazardous. Although DDPI can still be run as a TSR, LaserMaster includes DDPI overlays (conventionally called drivers) for *Microsoft Windows*, Versions 2.x through 3.0, *GEM*, Versions 2.x through 3.0, *Ventura Publisher*, Versions 2.x through 3.0, *WordPerfect*, Versions 5.0 and 5.1, and *Microsoft Word*, Version 5.0. The drivers are backed by 135 so-called Classic Typefaces that are the equivalents of PostScript's 35 fonts and more.

CONTINUES

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LASERMASTER

CONTINUED

SLOW INSTALLATION

Installing the software is relatively painless, although tedious. The initial installation provides the routines for the fonts and font management. And although you'll need only about 15 minutes to install the LM 1000's drivers, installing the *Windows* fonts took almost an hour and a half.

Window's WYSIWYG environment necessitates corresponding screen fonts for every printer font. Creating the corresponding screen fonts for the basic selection of 35 printer fonts in 8-, 10-, 12-, 14-, 16-, 18-, 24-, and 32-point sizes required almost an hour on a 25-MHz 386. Larger sizes were unavailable in a VGA environment. You'll need 3MB to 8MB of disk space to store the fonts, depending on your point-size requirements. Although this may sound like a lot, it's a reasonable requirement for a dedicated typesetting system. Of course, printed fonts can be scaled beyond the limits of your video system to the limit allowed by your application. LaserMaster offers additional typefaces in groups of 100, and charges \$1,000 per group.

FAST GRAPHICS

The LM 1000 did well on PC Labs' speed tests; however, the results had to be calculated manually because of the lack of a standard PC printer emulation. We printed the PC Labs half-tone test image with *PageMaker* running under a copy *Windows* 3.0, which included a driver for the LM 1000. This meant that the image was printed directly to the LaserMaster interface without having to go through the *Windows* Spooler. The LM 1000 zipped through our graphics test at 1.5 gppm—faster than most of the laser printers in this roundup. The speed is even more impressive when you consider the fact that the LM 1000 is printing at a resolution 250 to 300 percent higher than any other printer we tested.

The printed image was equally impressive. The high resolution was apparent in the curved line section of the PC Labs test image: There is not a

jagged edge in sight. But the true impact of the LM 1000's high-resolution printing is hardly noticeable in the two-by-two-inch graphic used in the printer test; when we scaled the image 400 percent during printing, we couldn't help but see the impact of the increased resolution. Instead of breaking up the gray scales as a 300-dpi machine would have done, the LM 1000 produced smooth transitions and tremendous clarity—albeit slightly below the resolution of even a low-end Linotronic typesetting machine. And, again the printer's speed was impressive; the LM 1000 produced the enlarged 7.8- by 10.5-inch image at a rate of .7 gppm.

At \$7,495 (\$7,995 for MCA), the LM 1000 is not a system you'll casually add to your PC. Although both the Varityper VT600P (reviewed in last year's issue) and the Printware 720 IQ Professional II (reviewed in this issue) are more expensive, they're also easier to use because the former comes with Adobe PostScript, and the latter provides a PostScript emulator. Furthermore, for high-quality text printing, there are other PostScript printers with the same number of fonts at half the price. But if your graphic work is supported by one of LaserMaster's drivers—or you're willing to work with a TSR—you'll be tempted by the output you can get from the LM 1000. Even with its limitations, the LM 1000 produced some of the best graphics we've ever seen from a PC printer. ■

LaserMaster LM 1000

LaserMaster Corp., 7156 Shady Oak Rd., Eden Prairie, MN 55344; (612)-944-6069.

List Price: \$7,495 (ISA); \$7,995 (MCA).

Standard Warranty: 90 days on parts and labor for the engine; one year on parts and labor for the controller card. **Dimensions (HWD):** 18 x 19 x 8.5 in. **Weight:** 38 lbs.

Emulations: PostScript emulator. **In**

Short: The LM 1000's high speeds and super-high-resolution graphics are offset by a high price and no standard emulations. A great specialty printer, but certainly not for the mainstream.

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Add the following amounts to the base configuration prices shown above

Hard Drive: MB/MS	40/25	80/19	125/19	178/15
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VGA-Mono	\$639	\$758	\$929	\$1229
VGA-Color	\$825	\$944	\$1115	\$1415
SVGA-Color*	\$960	\$1079	\$1250	\$1550

* SVGA 1024 x 768 interlaced

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Horses.

THIS ISSUE!

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-Computer Shopper, Cover Story

"The Best Low Cost Alternative Around!"

-PC Magazine, 25MHz 386PC's

"The Biggest Bargain In Personal Computing"

-Computer Buyer's Guide, Cover Story

386/25-\$1149

386/25 \$1149

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Landmark™ Speed 33.6MHz,
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1.2MB or 1.44MB Drive,
101-Key Keyboard,
2 Serial and 1 Parallel Ports

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- True 25MHz Intel 80386 CPU Operating with Zero Wait States
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- High performance 16bit VGA Cards with optional 1024x768 capability on all VGA Systems
- 1:1 Interleaving Hard Drive Floppy Drive controllers, 1Mb/Second disk transfer rates on all standard Drives
- Enhanced 101-key Click/Tactile Keyboard
- 2 serial & 1 parallel ports
- High Capacity 200Watt System Power Supply

- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387, or Waitek Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 6 Disk Drive bays

Options:

- Low profile Slim-Line Case with 3 Disk bays
- Full Size Tower* Case with 6 Disk Drive bays
- Mini Size Tower* Case with 4 Disk Drive bays
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PC BRAND 386/25

Add the following amount to the base configuration price shown above

Hard Drives: MB/MS	40/25	90/19	125/19	175/15	320/16	640/15
Mono	\$480	\$599	\$770	\$1070	\$1870	\$2730
VGA-Mono	\$639	\$758	\$929	\$1229	\$2029	\$2889
VGA-Color	\$825	\$944	\$1115	\$1415	\$2215	\$3075
SVGA-Color*	\$960	\$1079	\$1250	\$1550	\$2350	\$3210

* SVGA 1024 x 768 Interlaced

*Tower is a registered trademark of NCR Corp.

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486/33 CALL

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- FCC Class "A", Intended for business use
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- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Hard Drive Floppy Drive Controllers, 1 Mb/Second disk transfer rates on all standard Drives
- Enhanced 101-key Click/Tactile Keyboard
- I/O Ports-2 serial, 1 parallel

- High Capacity 200Watt System Power Supply
- 7 Slot motherboard design with one 32bit proprietary Zero Wait States Slot
- AMI BIOS with MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- Medium foot print case w/6 Disk Drive bays
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Options:

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PC BRAND 486's

Add the following amount to the base configuration price shown above

Hard Drives MB/MS	80/19	125/19	178/15	320/16	640/15
Mono	\$599	\$770	\$1070	\$1870	\$2730
VGA-Mono	\$758	\$929	\$1229	\$2029	\$2889
VGA-Color	\$944	\$1115	\$1415	\$2215	\$3075
SVGA-Color*	\$1079	\$1250	\$1550	\$2350	\$3210

* SVGA 1024 x 768 interlaced

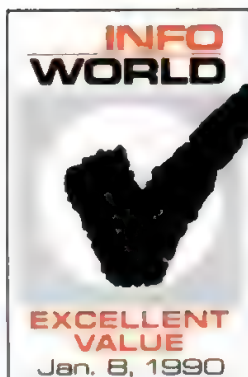
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** Not available in Slim-Line Case

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101-KeyBoard,
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386/33 \$1799

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Norton SI 45.9
Landmark™ 58.7MHz,
1024K RAM,
1.2MB or 1.44MB Drive,
101-KeyBoard,
2 Serial and 1 Parallel Ports

Standard Features:

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- True 25 or 33MHz INTEL 80386 CPU operating w/Zero Wait States with 43.5 or 58.7MHz Effective Throughput
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- FCC Class "A", Intended for business use
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- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Hard Drive Floppy Drive Controllers, 1 Mb/Second disk transfer rates on all standard drives
- Enhanced 101-key Click/Tactile Keyboard
- I/O Ports-2 serial, 1 parallel

- High Capacity 200Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387 or Weitek CoProcessor support
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Hard Drives: MB/MS	40/25	80/19	125/19	178/15	320/16	640/15
Mono	\$489	\$599	\$770	\$1070	\$1870	\$2730
VGA-Mono	\$639	\$758	\$929	\$1229	\$2029	\$2889
VGA-Color	\$825	\$944	\$1115	\$1415	\$2215	\$3075
SVGA-Color*	\$960	\$1079	\$1250	\$1550	\$2350	\$3210

* SVGA 1024 x 768 interlaced

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NewGen TurboPS/360

by Edward Mendelson

You can add more memory to almost every vendor's printers. NewGen Systems Corp.'s PostScript-compatible printers are special in letting you increase both memory and resolution. You can buy the NewGen TurboPS/360 for \$4,995 and get a 300- by 600-dot-per-inch PostScript printer with 3MB of RAM—but if you don't have that much cash on hand, you can buy the TurboPS/300 for \$500 less and get a 2MB, 300- by 300-dpi printer that you can later transform into the higher-resolution model with an upgrade kit and a screwdriver. Because the upgrade costs \$995, you're probably better off starting out with the TurboPS/360, the model PC Labs chose to test.

At any resolution, the TurboPS models include HP LaserJet Series II, HPGL, and Epson LQ emulations in addition to their default PostScript mode. The printer's PostScript interpreter was written by RIPS and accepts Type 1 fonts. In PC Labs' performance tests, the TurboPS/360 printed the graphics page at a reasonably fast speed of 1 gppm. Although NewGen

PRINTERS LASERS

rates the printer at up to 8 text pages per minute, PC Labs' text file printed at only 2.1 ppm.

The TurboPS series uses the tried-and-true Canon SX engine, which NewGen puts in a case almost identical to that of the HP LaserJet Series II. The TurboPS/360 produces dark and well-defined output, with the precision of text and lines enhanced by the special high-resolution toner that NewGen ships with the printer (available separately for \$195). For the same

FONTS & FEATURES NewGen Turbo PS/360												
PostScript emulator												
	Helvetica			Times			Courier			Line Printer		
	Underline	Sub-Super	Italic	Underline	Sub-Super	Italic	Underline	Sub-Super	Italic	Underline	Sub-Super	Italic
8/9-point												
10-point												
12-point												
14-point												
Scalable												
HP LaserJet Series II												
	Underline	Sub-Super	Italic	Underline	Sub-Super	Italic	Underline	Sub-Super	Italic	Underline	Sub-Super	Italic
8/9-point												
10-point												
12-point												
14-point												
Scalable												

price, NewGen can supply an optional high-density black toner cartridge for images that include large areas of black. Of course, you can also plug in any standard EP-S cartridge instead of using one of these relatively expensive models.

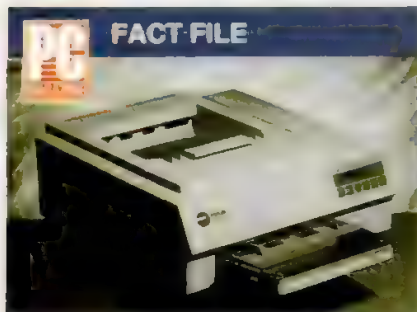
The PostScript output from the TurboPS/360 was impressively sharp and clear, although a random horizontal line occasionally appeared across the bitmap image in PC Labs' graphics file. With text files, we encountered an annoying problem during the first few minutes after turning the printer on. The first page or two printed in Courier had random words or letters placed a fraction of an inch above the line on which they belonged. NewGen was familiar with this problem and said that a forthcoming version of the firmware should correct it.

Different problems appeared in the printer's Epson and LaserJet Series II emulations. When we switched the printer to Epson emulation via the membrane

switches on the front panel and tried to print either graphics or text, the printer flashed its LED indicators for a while and then locked up. Since the front panel has no reset switch, we had to turn the printer off and on again before we could switch it to another emulation and start printing again. NewGen acknowledged that there were problems in its Epson emulation but had no explanation for the printer's failure on this test.

The results of the LaserJet emulation were slightly better. In PC Labs' tests, the printer had no trouble printing ordinary text—but at a glacial pace of 1 ppm. The emulation did not compensate for the slightly reduced print region of a PCL printer, and part of the first column of text was cut off. When we tried to print PC Labs' PCL test, which uses a full suite of PCL commands, the printer refused to print anything at all. The LED indicators on the front panel flashed but no pages appeared, even after we pressed the form-feed button. NewGen could offer no explanation for this problem.

If you're willing to live with such emulation problems—which may be fixed by the time you read this—the NewGen TurboPS/360 provides high PostScript resolution and some notable conveniences, especially if you plan to use it in a network that includes Macintosh machines. An AppleTalk connector is built into the printer, and an optional SCSI interface lets you add a hard disk for font storage, as you can with the Apple LaserWriters. But if you want fast text printing and emulations that can pass PC Labs' compatibility tests, you may prefer to look elsewhere.



FACT FILE

NewGen TurboPS/360
NewGen Systems Corp., 17580 Newhope St., Fountain Valley, CA 92708; (714) 641-8900.
List Price: \$4,995 (TurboPS/360); \$4,495 (TurboPS/300); upgrade to 4MB RAM, \$399; upgrade to 5MB, \$798; optional envelope, letter, A4, B5, or legal tray, \$89.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 8.3 x 18 x 25 in.
Weight: 46 lbs.

Emulations: PostScript emulator, HP LaserJet Series II, HPGL, Epson LQ.

In Short: NewGen's 300- by 600-dpi PostScript printer produces high-quality PostScript output but prints text slowly and failed PC Labs' LaserJet and Epson emulation tests. The \$4,495 TurboPS/300 is a virtually identical model but with 300 dpi output; it can be upgraded in the field to the 360 with a \$995 upgrade kit.

NewGen TurboPS/480

by Edward Mendelson

From the outside, the only thing that distinguishes NewGen Systems' \$7,495 TurboPS/480 from the company's TurboPS/360 (reviewed above) is the name on the front. But what makes the real difference is the impressively increased PostScript resolution of the 480 model: 400 by 800 dots per inch, compared with the 300 by 600 you get from its less expensive sibling.

Another member of the family, the \$5,495 TurboPS/400 also looks almost identical to the TurboPS/480 from the outside: It uses the same enhanced ver-

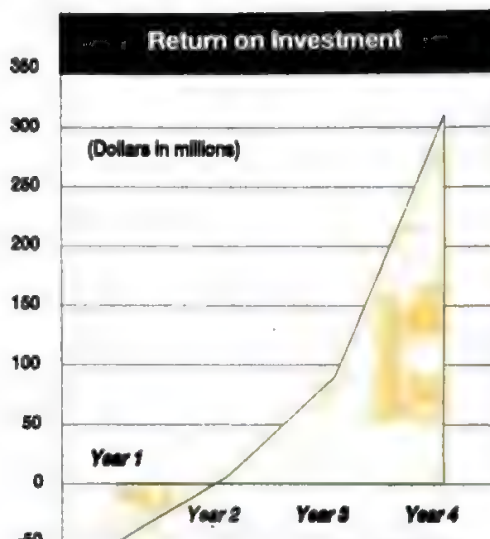
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well we crunch
numbers,
look at our
graphics.

Microsoft Excel for Windows.

"With solid spreadsheet and charting components and a comprehensive macro language integrated into a powerful graphical environment, Excel is no more 'just a spreadsheet' than a Ferrari or a Porsche is 'just a car.' "

PC Magazine

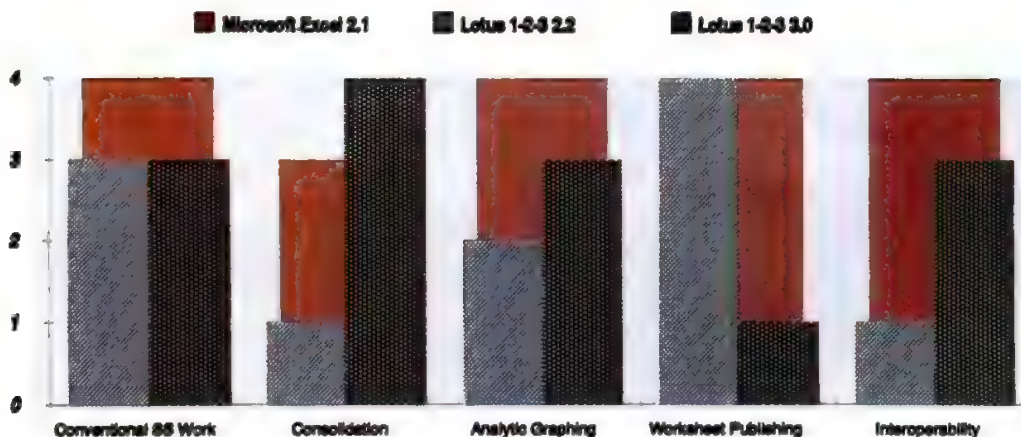
Recently, PC Magazine placed Microsoft Excel version 2.10 head to head with Lotus 1-2-3 release 2.2 and 3. They measured the essential criteria by which spreadsheets are judged. As you can see from the chart, Microsoft Excel proved to be superior in its balance of capabilities. Further evidence of the advantages of the graphical-based Microsoft Excel over the character-based Lotus 1-2-3 can be



Based on the findings of a recent study, switching to graphical applications can yield increased productivity and can result in these dollar savings. ***

seen in a recent study.

Over the years, graphical-based applications result in significant dollar savings since they are faster to learn, faster to use and less frustrating to master.

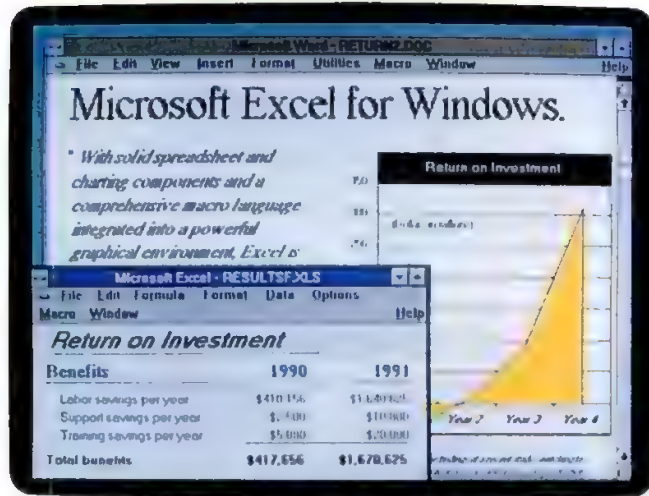


In this chart, PC Magazine** compares the salient spreadsheet criteria of Microsoft Excel and Lotus 1-2-3. As you can see, Microsoft Excel showed its superiority.

(Incidentally, this report was created using Microsoft Excel linked with Microsoft Word for Windows.)

If you read the report at the left, you can see in just a couple of seconds how well Microsoft® Excel for Windows™ can crunch numbers.

Which is exactly our point.
Whatever analytic case you're mak-



Windows can display Microsoft Excel and Word for Windows at the same time so you can see how all elements of your analysis will go together.

ing, it's much more easily made with a comprehensible, bottom-line report than with a row and column spreadsheet.

And that's not to give up one iota of analytic power.

Fact is, Microsoft Excel gives you more power to make sense of numbers than any other spreadsheet going. Simply because whether you're analyzing or reporting, you get the power of the Microsoft Windows environment every step of the way.

For instance, you can display multiple spreadsheets simultaneously. So you can see all your data and all the relationships at once.

If you want to link a couple of those spreadsheets, just point, click.

And consider it done.

Or if you want to pull data from a variety of databases, you guessed it. Point, click and done.

Then before you wind up, you can do an audit of every formula to give you absolute confidence in your result.

And onto the finish. Which is where your results will really shine.

You can simply dress up your spreadsheet with color, shading, borders and a variety of type fonts.

Or you can chart your numbers hun-

Microsoft Excel - FINANCE.XLS

File Edit Formula Format Data Options Macro Window Help

Three-Year Profit and Loss Statement

Revenues and Costs	1990	1989	1988
Net Revenues	\$432,806	\$318,663	\$309,266
Cost of Revenues	79,809	65,670	58,348
Research and Development	79,809	52,361	33,081
Sales and Marketing	87,680	68,108	62,490
General and Administrative	27,653	18,537	12,594
Income from Operations	\$157,955	\$114,007	\$142,756
Non operating income	7,004	6,629	3,715
Income Before Taxes	164,959	120,636	146,471
Provision for income taxes	67,092	48,094	59,321
Net Income	\$98,567	\$71,832	\$87,150
Capital Expenditures	63,470	52,765	29,420
Depreciation	9,863	8,560	7,658
Assets and Liabilities			

Under the Windows environment, WYSIWYG lets you see exactly how your work will print out while you're creating it.

dreds of different ways to make them look really impressive.

Then when you want to pull out all the stops, you can easily create full-blown reports that mix text, graphics and data. Just copy and paste using other Windows applications, like Word for Windows.

And if you're starting to worry about change, don't. Microsoft Excel reads and writes Lotus® 1-2-3® files. So making a change for the better is easier done than said.

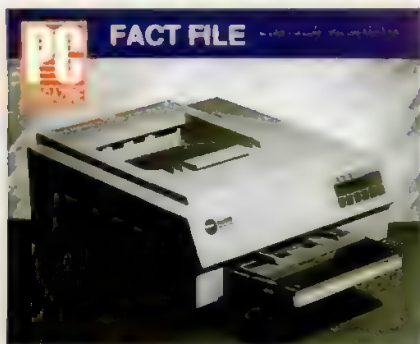


To prove it, we'll send you a free* fully functional Working Model of Microsoft Excel for Windows. Simply crunch these numbers: (800) 323-3577, Dept. M63.

That way you can see for yourself if our final analysis is correct.

Microsoft
Making it all make sense

PRINTERS LASERS



NewGen TurboPS/480

NewGen Systems Corp., 17580 Newhope St., Fountain Valley, CA 92708; (714) 641-8900.

List Price: \$7,495; optional envelope, letter, A4, B5, or legal tray, \$89.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 8.3 x 18 x 25 in.

Weight: 46 lbs.

Emulations: PostScript emulator, HP LaserJet Series II, HPGL, Epson LQ.

In Short: NewGen's 400-by-800 dpi PostScript emulation produces exceptionally high-quality output, although text printing is slow. Like the 360 model, the 480 failed PC Labs' LaserJet and Epson emulation tests, a showing that doesn't inspire confidence. The \$5,495 TurboPS/400 is a 400-dpi, 3MB model upgradable to the TurboPS/480 with a \$2,295 user-installable kit.

CIRCLE 418 ON READER SERVICE CARD

tionally interesting printer. Its PostScript resolution is among the highest available from a desktop printer, and the RIPS PostScript interpreter accepts Type 1 fonts. The LaserJet emulation comes with versions of Times Roman and Helvetica built-in and cleverly generates these fonts by using the versions built into the PostScript emulation, but with modified character widths. The printer doesn't have a cartridge slot, and NewGen recommends against trying to use 300-dpi LaserJet soft fonts at 400 dpi or better; in any case you'll probably use the LaserJet emulation only for plain text. Unfortunately, the 480, like the 360, doesn't adjust its margins when it switches into LaserJet emulation, so the first column of text prints incompletely.

If you're thinking of buying the less

Fonts & Features

NewGen Turbo PS/480

PostScript emulator			
Helvetica	Times	Courier	Line Printer
Underline	Underline	Underline	Underline
Sub/Super	Sub/Super	Sub/Super	Sub/Super
Italic	Italic	Italic	Italic
Bold	Bold	Bold	Bold
8/9-point			
10-point			
12-point			
14-point			
Scalable			

HP LaserJet Series II			
Helvetica	Times	Courier	Line Printer
Underline	Underline	Underline	Underline
Sub/Super	Sub/Super	Sub/Super	Sub/Super
Italic	Italic	Italic	Italic
Bold	Bold	Bold	Bold
8/9-point			
10-point			
12-point			
14-point			
Scalable			

expensive TurboPS/400 and upgrading to the 480, make sure you've had some experience installing expansion boards and RAM chips first. The kit requires you to pull some chips already in the printer and plug in 16 RAM chips, increasing the printer's RAM from 3MB to 5MB. The installation instructions list more than 30 steps.

The NewGen TurboPS/480 gives you exceptionally high PostScript resolution at a fairly reasonable price. And if you're in the market for this class of printer, you may not care about problems in its LaserJet or Epson emulations, slow text printing, or even those misplaced Courier

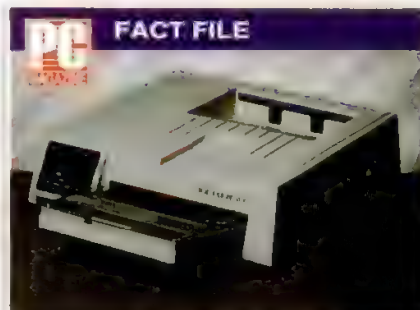
characters during the first few minutes after the printer is turned on. On the other hand, you may prefer a printer that performs all its operations flawlessly rather than one that is still rising on its learning curve.

Okidata OkiLaser 400

by Bill O'Brien

Not much has changed with Okidata's OkiLaser 400 since we last reviewed it in our issue of June 12, 1990—and not much had any reason to change. At \$1,395, the OkiLaser has a 4-ppm, LED-array Oki-Electric engine and scalable fonts that pack quite a bit of punch into a 5.3- by 17.5- by 22.5-inch case with HP LaserJet Series II emulation. Nevertheless, what was an Editor's Choice machine five months ago is now only one of many very good low-cost laser printers.

Perhaps most importantly, the OkiLaser 400 surpasses the majority of its competition in the font department. There are 17 fonts resident in the machine, and they emulate five HP font cartridges: A, B, C, F, and L. HP's Y cartridge is also among those emulated, but Okidata is quick to point out that the baseline and underline distances for those fonts are slightly different in the 400 than in the actual HP cartridge. Additional fonts are



OkiLaser 400

Okidata, 532 Fellowship Rd., Mount Laurel, NJ 08054; (800) OKI-DATA, (609) 235-2600.

List Price: \$1,395; upgrade to 1.5MB RAM, \$495; upgrade to 2.5MB, \$995; optional legal or envelope tray, \$89.

Standard Warranty: One year from date of purchase, dealer or depot service.

Dimensions (HWD): 5.3 x 17.7 x 24.9 in.

Weight: 23 lbs.

Emulations: HP LaserJet Series II.

In Short: Great graphics and superior text handling with the equivalent of seven HP font cartridges add up to an excellent choice for a versatile 4-ppm printer.

CIRCLE 419 ON READER SERVICE CARD

sion of the Canon SX engine but produces 400- by 400-dpi output. You can upgrade the 400 to become the 480 by turning the printer upside down and installing a \$2,295 upgrade kit, plus some RAM chips that bring the 400 from its standard 3MB of RAM to the 480's standard 5MB. But you can't upgrade the 360 to become either the 400 or the 480.

If you've read the review of the TurboPS/360, you know what to expect from the 480. The 480 produces sharper output, but the speed is almost identical: 1 gppm for PC Labs' graphics file, 2.1 ppm for text. Like the 360, the 480 tended to misalign characters in the Courier font during the first few minutes after being turned on—a problem that NewGen expects to fix with a new version of the printer's firmware. Unlike the 360, the 480 did not introduce a random horizontal line in the bitmap image in the graphics tests.

Also like the 360, the 480 failed PC Labs' Epson emulation tests. It was able to print only plain text in HP LaserJet Series II mode and was unable to print anything when given the full LaserJet emulation test.

If a future version of the TurboPS/480 solves all these problems and produces faster text output, this will be an excep-

If you think the LaserPrinter E looks good in person,



wait till you see how it looks on paper.

	The New IBM LaserPrinter E	HP LaserJet IIP
Speed	✓ up to 5 ppm	up to 4 ppm
Speed upgrade option	✓ up to 10 ppm	No
Adobe PostScript option	Yes	Yes
Printer emulation	✓ IBM, HP PCL	HP PCL
Std. plotter emulation	✓ Yes	No
Font card slots	✓ 2	1
Std. input paper tray capacity	✓ 200	50
Std. output paper tray capacity	✓ 100	50
Opt. sec. input paper tray capacity	✓ 500	250
Opt. envelope tray capacity	✓ 75	20
Mfr. suggested retail price	✓ \$1495	\$1495

Any way you look at it, the new IBM LaserPrinter E gives you more for your money than any other laser printer in its price range.

For the same price as the HP LaserJet IIP, the IBM LaserPrinter E gives you all the advantages of laser quality output 25% faster, with four times the paper capacity, and twice the number of font slots.

Plus the IBM LaserPrinter E is unique in its price range because it lets you customize your printer's

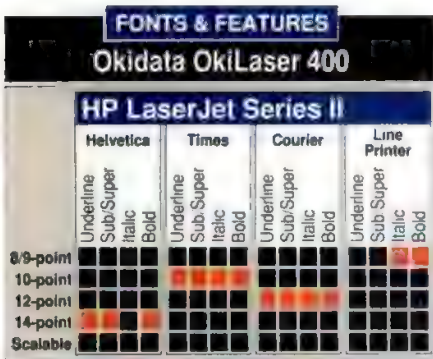
speed and features to meet your exact needs. And that makes it the only affordable laser printer that lets you buy now and grow later.

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creative flexibility, too.

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The new IBM LaserPrinter E. Suddenly, nothing else measures up.



available for \$195 on proprietary, credit-card-size cartridges from Okidata.

Four manuals accompany the printer, and they divide the information about the OkiLaser 400 into separate logical segments covering setup, owners' questions, problem areas, and page composition. The QuickStart manual is superb, guiding the meek and timid through the toner and photoconductor installation with full illustrations as well as text. The Owners' Manual contains all the information you'll need beyond the initial setup instructions; the Troubleshooting Manual is your source for ready answers to problems, and the Fonts and Composition Manual will barage you with information about the variety of fonts available both in the printer or as additional font cartridges.

The OkiLaser 400's toner cartridge is the closest thing to art deco you'll find in a printer—a spun aluminum cylinder with a sliding window. Although the OkiLaser has no toner reclamation system, Okidata says that the cartridge design does collect some of the unused toner from the photoconductor.

Replacement toner cartridges are \$33—slightly higher than some others, but Okidata claims a 2,500-copy life for each cartridge. Although the photoconductor costs a whopping \$289, Okidata maintains that it has a life span of 15,000 copies. That is a 50 percent higher copy count than a TEC laser engine, for example, but the cost is nearly double that of an equivalent TEC part.

The PC Labs performance tests proved no great challenge to the OkiLaser 400. It zipped through the graphics speed test, averaging 1.2 gppm under its HP LaserJet Series II emulation. The LED array in the OkiElectric engine produced crisp images with solid blacks and distinct grays. Text speed was equally dexterous; the unit's average throughput coincided with its rated 4.1 ppm through the run of 20 test sheets.

PRINTERS LASERS

The PCL torture test was also a walk in the sun. The printer accepted downloaded font definitions and macros with ease, and the only stumbling block it found in the entire suite of tests was the IBM high-order characters. Roman-8 is the printer's default symbol set under the HP emulation, but a control code switches the OkiLaser over to the IBM character set.

The 16-character LCD on the front panel will guide you through a variety of setup selections, including font and symbol set choices. Options are mixed and matched through hierarchical menu displays activated by the panel's membrane buttons. The one-line LCD approach may no longer be new, but it still works just fine for the OkiLaser 400.

The OkiLaser 400 was our Editor's Choice in June, and for good reason. Now, your choices are considerably broader in this category, and although your buying decision may rest on which low-cost laser is the *lowest*-cost laser, you can't go wrong with the OkiLaser 400.

Okidata OkiLaser 820 by Bill O'Brien

Okidata has taken the proven design of its OkiLaser 800 and its 8-ppm OkiElectric LED array engine and created the OkiLaser 820, equipped with 512K of mem-

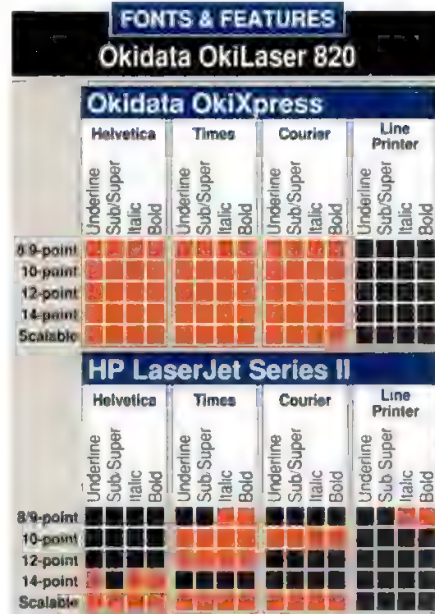
ory and packed with HP LaserJet Series II and IBM Proprinter emulations. It carries a suggested retail price of \$2,295, and its probable street price of under \$2,000 is highly reasonable for an 8-ppm laser printer.

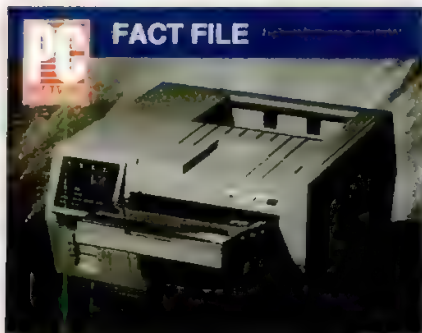
The OkiLaser 820 whizzed through PC Labs' graphics speed test, averaging 2.5 gppm under its HP LaserJet Series II emulation.

The printer comes with 17 resident fonts that emulate five HP font cartridges: A, B, C, F, and L. HP's Y cartridge is also among those emulated, but the baseline and underline distances for those fonts are slightly different in the 820 than they would be in the actual HP cartridge. Additional fonts are available on proprietary credit-card-size cartridges from Okidata for \$195.

Standard fare with the 820, as with all Okidata laser printers, are four operation manuals. They divide the information about the printer into separate logical segments covering setup, owners' questions, problem areas, and page composition. The QuickStart Manual is an excellent guide to setting up the printer and installing the consumables. The Owners' Manual contains all of the information you'll need beyond the initial setup instructions. The Troubleshooting Manual contains explanations for error messages that might appear in the LCD panel, and the Fonts and Composition Manual is filled with a host of details about the variety of fonts available both within the printer and in additional font cartridges.

The OkiLaser 820's spun-aluminum toner cartridge is designed to provide some toner reclamation, although no true reclamation system is implemented in the printer. At \$33, the cartridge will produce approximately 2,500 copies before it needs to be replaced. The separate photoconductor cartridge is a startling \$289, but with an average life span of approximately 14,000 copies, the dual-cartridge system comes within \$5 of Canon's single-cartridge cost for an equivalent period.





FACT FILE

OkiLaser 820

OkiLaser 840

Okidata, 532 Fellowship Rd., Mt. Laurel, NJ 08054; (800) OKI-DATA.

List Price: \$2,295 (820); \$3,595 (840); font cards, \$195-\$395; optional second paper tray, \$229; multiuser parallel or serial interface (820), \$395.

Standard Warranty: One year from date of purchase, dealer or depot service.

Dimensions (HWD): 8.5 x 17.7 x 24.9 in. (both units).

Weight: 37 lbs. (both units).

Emulations: PostScript (for the 840), HP LaserJet Series II, IBM Proprinter (for the 820); Diablo 630.

In Short: Okidata's big boys offer HP emulation in both the 820 and 840, with the 840 diverting to PostScript while the 820 contains an IBM Proprinter emulation. Both have a large selection of bitmapped and scalable fonts equivalent to seven HP font cartridges.

CIRCLE 420 ON READER SERVICE CARD

PC Labs' performance tests proved to be no problem for the OkiLaser 820. It whizzed through the graphics speed test, averaging 2.5 gppm under its HP LaserJet Series II emulation; that number dropped to 2.2 gppm under the Proprinter emulation. The LED array produced crisp images with solid blacks and distinct grays. Text handling was equally fast; the 820 ran its rated 8 ppm in both HP and IBM modes.

The PCL torture test was no torture at all. The OkiLaser 820 accepted downloaded font definitions and macros with ease. Roman-8 is the standard default symbol for HP emulation, but IBM high order characters are obtainable by sending the printer a short control code.

If control codes aren't your cup of tea, the 16-character LCD front panel will take you through every possible combination of the printers' features and abilities at the press of a few membrane buttons. Options are mixed, matched, and selected through a series of hierarchical menus. The same one-line LCD is carried through Okidata's entire line of printers and works quite well.

While its \$2,295 list price may look less appealing than that of an HP LaserJet

PRINTERS LASERS

Series II, when you add the cost of six font cartridges to the price of the LaserJet you'll see the OkiLaser 820 in a much more attractive light. Throw in IBM Proprinter emulation for good measure and this printer's overall flexibility makes it an excellent candidate for your output chores.

Okidata OkiLaser 840

by Bill O'Brien

The OkiLaser 840 is built on the same 8-ppm LED array engine found in the OkiLasers 800 and 820. The printer's \$3,595 price includes a native PostScript mode and both HP LaserJet Series II and Diablo 630 emulations. With exactly the same capabilities as Apple's 4-ppm Personal LaserWriter, it costs only \$300 more but runs at nearly twice the speed.

The OkiLaser 840 fairly bulges with features. There is, of course, the requisite control panel with a 16-character LCD readout for manually cycling through the printer's fonts and operating compatibilities. But more important, Okidata has implemented an Auto Emulation command that lets your software select the PostScript native mode or either of the other emulations simply by sending the printer a three-character escape sequence. While this does not rival the true auto-sensing ability of the QMS PS-410, it does

make networking the OkiLaser 840 in a mixed environment much easier than the task might otherwise be. A brace of parallel, serial, and AppleTalk ports assist in minimizing system integration headaches.

The PostScript native mode provides the OkiLaser 840 with 37 scalable fonts, but these are not restricted to the PostScript environment only. Switch into HP emulation and it's as if you had a LaserJet Series II with seven font cartridges plugged in at the same time. The 840 emulates the A, B, C, F, L, S1, and S2 cartridges, and it uses fonts similar to HP's Y cartridge (although again, the baseline and underline distances are different in the version Okidata has implemented).

Okidata has packaged plenty of information with the OkiLaser 840. Okidata's four great manuals deal individually with quick setup, general user information, printer problems, and fonts and composition. Collectively they encompass some 320 pages of documentation.

The OkiLaser 840's 2MB of RAM earned the printer a rating of 0.8 gppm in PostScript mode. It's not the fastest of the 8-ppm PostScript printers, but its ranking is comparable. More important is the graphics quality. Without the added distortion of mirrors, the LED array engine produced a graphics image that was noticeably crisper than those from conventional laser engines. The OkiLaser 840 produced text at 7.7 ppm.

OkiLaser 800 owners can upgrade to the 840 specification for \$1,895, and the total cost is only \$95 over the price of the 840 itself. Whether as an upgrade or a first purchase, the OkiLaser 840 is the only route to take if you need both PostScript and PCL.

FONTS & FEATURES Okidata OkiLaser 840												
PostScript												
	Helvetica				Times				Courier			
	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold
8/9-point												
10-point												
12-point												
14-point												
Scalable												
HP LaserJet Series II												
	Helvetica				Times				Courier			
	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold
8/9-point												
10-point												
12-point												
14-point												
Scalable												

Olivetti PG 306

by M. David Stone

The PG 306 from Olivetti Office USA is one of the few laser printers built around the 6-page-per-minute TEC LB 1305 B engine with a personality all its own. Although its \$1,595 list price is typical for HP LaserJet Series II-compatible printers using this engine, as is its size (8 by 24.8 by 15.5 inches (HWD) with a paper tray installed), the PG 306's case, controls, and \$1,200 Bauer PDL add-in card are anything but commonplace.

The PG 306's control panel takes an unusual approach to printer management.

The unit has five membrane switches, including the on-line/off-line switch, and three other switches that activate additional functions, which change as you move through the printer's menus. These functions are clearly defined in the two-line LCD above them.

For example, set the printer off-line, and the three buttons read Print Test, Font Test, and Reset. Hit the button labeled Next, and the choices change to Font Menu, Paper Options, and Orientation. As you move through the menus, the choices unfold naturally, and the options are where you would expect them to be.



Olivetti PG 306

Olivetti Office USA, 765 US Highway 202, Bridgewater, NJ 08807; (201) 526-8200.

List Price: \$1,595; upgrade to 1.5MB RAM, \$420; upgrade to 2.5MB, \$745; upgrade to 4.5MB, \$1,520; PostScript-compatible board, \$1,200; emulation card, \$100; font cards, \$200-\$300 (HP mode), \$399 (PostScript mode); optional exit tray, \$39; optional serial port, \$59.

Standard Warranty: One year on-site parts and labor.

Dimensions (HWD): 8 x 24.8 x 15.5 in.

Weight: 35.3 lbs.

Emulations: HP LaserJet Series II, IBM Proprinter, Epson FX.

In Short: In addition to well-marked controls, what differentiates the PG 306 from the crowd of 6-ppm TEC engine-based lasers is the \$1,200 optional Bauer PDL board, which provides PostScript compatibility but at very slow speeds.

CIRCLE 421 ON READER SERVICE CARD

If you're familiar with printers, you should be able to set up the 35-pound PG 306 without even opening up the user's manual. If not, you'll find all the installation information you need in a reasonably readable format.

Because the PG 306 is built around the TEC 1305 engine, it uses a separate drum unit, developing unit, and toner cartridge, which means that installing and replacing the consumables will be somewhat more difficult than loading an all-in-one cartridge. It also leaves the drum exposed, so that you can accidentally damage it if you're not careful.

PRINTERS LASERS

The TEC engine's paper handling is better than most. The printer's 150-page paper tray can be adjusted to accommodate paper sizes from envelope to legal. A facedown bin lets paper fall in collated order, while an alternate faceup exit provides a straight-through path for heavy stock. The output tray for faceup exit is a \$39 option.

In LaserJet Series II mode, the PG 306 is remarkably fast, with a measured text speed of 6.1 ppm and a measured graphics speed of 1.8 gppm on the PC Labs tests. Unfortunately, this speed does not carry over to the printer's PostScript-compatible mode, which uses Bauer PDL rather than Adobe PostScript. In our tests, the PostScript text speed was a disappointing 2.7 ppm, and the graphics speed was an abysmal 0.15 gppm. If you use PostScript often, you'll be spending a lot of time waiting for this printer.

As for output, the printer yields crisp text characters and solid black areas for graphics. When printed in PostScript or LaserJet Series II mode, the scanned photo image and the gray scale in our tests retained the appropriate level of detail. And, both emulations passed our compatibility tests without problems.

The PG 306's Bauer PDL option is a card with 2MB of RAM and a serial port. (In fact, all the RAM upgrades include a serial port.) Installation involves removing a plate from over the memory slot, sliding the card in, and tightening two thumbscrews. Other candidates for the memory slot are a serial port by itself for \$59, a 1MB RAM upgrade for \$420, a 2MB RAM upgrade for \$745, and a 4MB RAM upgrade for \$1,520. The base memory in the printer is 512K, so that the maximum memory is 4.5MB without the PostScript option or 2.5MB with it.

The Bauer PDL board comes with variations on Dutch (similar to Times Roman), Swiss (similar to Helvetica), and Courier fonts in firmware, and offers the 22 remaining standard PostScript fonts in downloadable format. The additional standard fonts are also available on a font card for \$399. The Bauer PDL fonts are not available for the LaserJet emulation.

The only other options are font cards and emulation cards for the printer's two slots, at \$200 to \$300 per font card for HP mode, and \$100 each for IBM Proprinter and Epson FX emulations. Olivetti says the printer will also accept HP-compat-

FONTS & FEATURES

Olivetti PG 306

HP LaserJet Series II															
Helvetica				Times				Courier				Line Printer			
Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															

IBM Proprinter															
Bold				Italic				Sub/Super				Underline			
10 cpi															
12 cpi															
Compressed															
Proportional															

ible soft fonts. As shipped, the LaserJet Series II emulation comes with Line Printer in standard font and with Courier in standard, bold, and italic fonts.

Olivetti estimates the street price for this printer at \$1,150, which would make the PG 306 somewhat overpriced in the real world. However, the price also includes a one-year on-site warranty through Bunker-Ramo, an Olivetti company. If you can find the printer at a more competitive price, or if you are planning to buy an on-site service contract anyway, the PG 306 is well worth considering for its LaserJet Series II emulation, if not for its PostScript-compatible mode.

Packard Bell PB9500

by M. David Stone

In the past year, we've seen several TEC 1305-based LaserJet Series II-compatible printers that were virtually identical, right down to the control panel. Consider the

FONTS & FEATURES

Packard Bell PB9500

HP LaserJet Series II															
Helvetica				Times				Courier				Line Printer			
Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															



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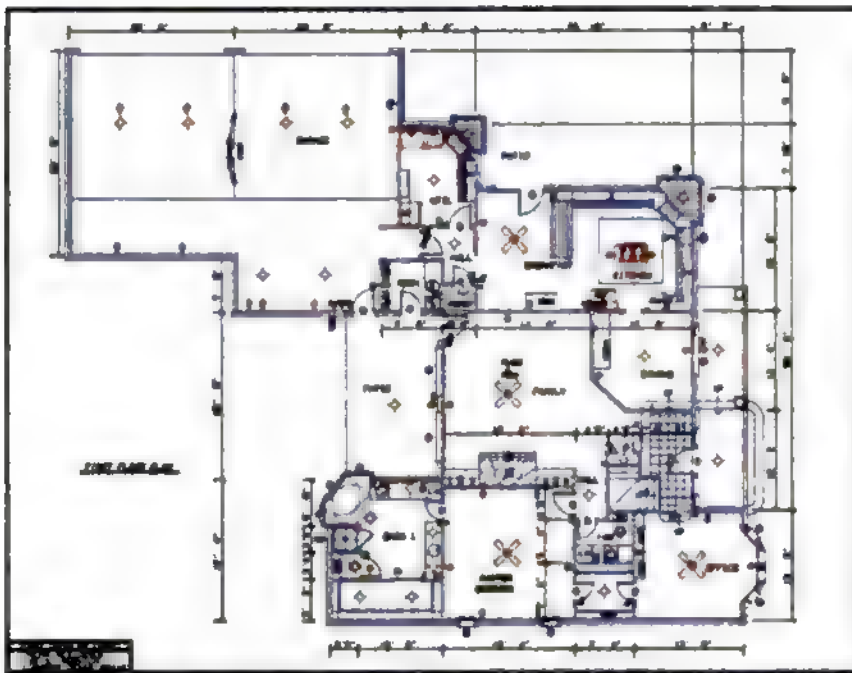
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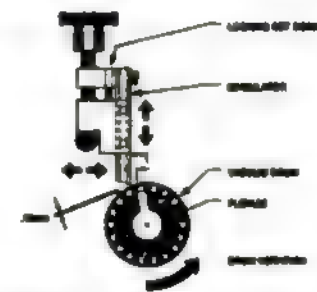
OPERATIONAL BLOCKS

OPERATIONAL BLOCKS

The diagram problem is solved by separating the bottom edge of the block, and then the top edge, and the top edge of the block is placed on the bottom edge of the block, and the bottom edge of the block is placed on the top edge of the block. The diagram is then placed on the bottom edge of the block, and the top edge of the block is placed on the bottom edge of the block. The diagram is then placed on the bottom edge of the block, and the top edge of the block is placed on the bottom edge of the block.

PLACEMENT

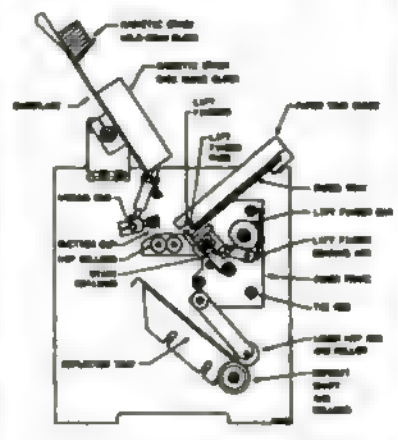
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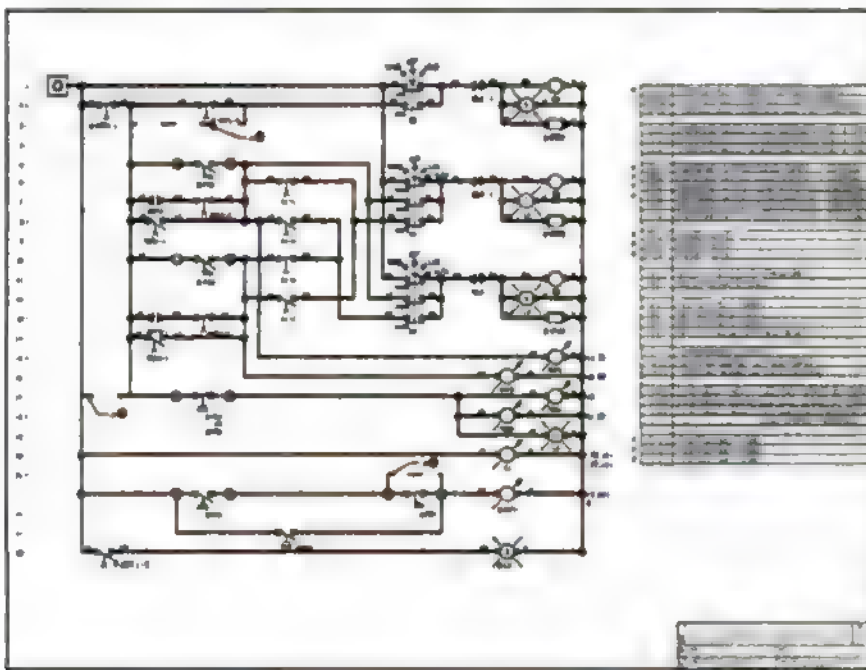
TECHNICAL DRAWING

Page 1

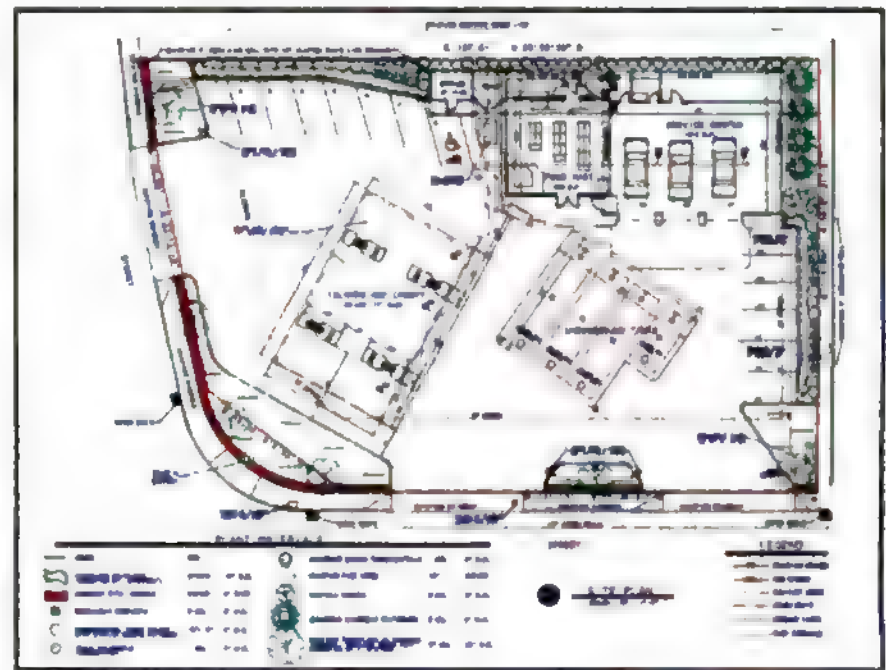
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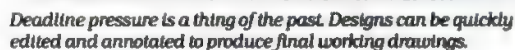
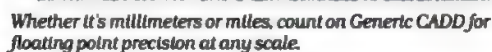
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LASERS ONLY A DEC USER COULD LOVE

Without offering such standard emulations as HP LaserJet, PostScript, IBM Proprinter, Epson, or even Diablo, DEC's pair of lasers are limited in the PC marketplace. A planned PostScript-compatible option should make these two lasers more useful.

by Bruce Brown

Digital Equipment Corp. sells printers, terminals, and other peripherals to companies that don't use Digital's computers. In the case of the DEC Laser 2100 and DEC Laser 2200, however, it makes little sense to purchase one at this point if you're not a DEC computer customer. A PostScript emulation option is in the works but not yet available, and the only current printing mode is the Digital LN03 ANSI standard—hardly a printer configuration you'll find supported in common PC software. If you run either DEC laser from a VAX computer you can print PostScript files directly, but the PC-compatible world will have to wait.

DEC's current lack of compatibility extends even to PC Labs' printer tests, which is why we've pulled this review out of the main roundup of lasers. Although we were able to run our text speed tests, graphics results will have to wait for the upcoming PostScript-compatible option.

The DEC Laser 2100 and 2200 both use the 300-dot-per-inch, 8-ppm Canon SX laser engine. The 2100 lists for \$2,695 with standard 512K memory. The 2200 costs \$3,999. Digital printers are sold only through DEC and significant discounts based on total order amounts are available, though not on a per-printer basis.

The DEC Laser 2100 is approximately the same size as other Canon SX-based printers—9 by 17.8 by 24.8 inches (HWD)—and weighs 47 pounds. The printer has both a Centronics parallel port and serial ports; it also comes with a serial port adapter to use with an RS-423 cable that's included.

Other than greater standard memory (1MB instead of 512K) and a slightly greater size and weight, the

DEC Laser 2200's big difference is duplex paper-handling. You switch between simplex and duplex modes via a front-panel switch or software control. The mechanical hardware for printing on both sides of a single sheet is identical to that used in the Hewlett-Packard IID, and worked smoothly.

The Canon SX engine used in the DEC lasers has a life expectancy of 300,000 sheets and a monthly duty cycle of 10,000 sheets. A single-component toner and developer cartridge, the same as the one used by the HP LaserJet Series II, is good for about 4,000 sheets and lists for \$125 from Digital. The manufacturer does not publish per-page costs, but based on the list prices, the cost of printer consumables (not counting paper) is 3.1 cents per page.

The DEC Laser 2100 cranked out 7.5 pages per minute in our text speed test. The DEC Laser 2200 attained a speed of 7.6 ppm in simplex mode, and 6.4 ppm in duplex mode. Because the DEC Lasers don't work with any of our test emulation modes, we were unable to obtain test results for graphics printing. We were also unable to print the IBM high-order character set.

The DEC Lasers come with four fonts standard: Courier 10-point portrait, Courier 10.3-point portrait, Courier 6.7-point landscape, and Elite 12-point portrait. Extra font cartridges cost from \$299 to \$399 and contain one font each. The DEC Laser 2100's 512K memory can be expanded to a maximum of 3.5MB.

You feed paper to the DEC Laser 2100 and 2200 via a single 200-sheet-capacity letter-size tray. With the tray in place you can also feed single sheets and envelopes manually. Legal-size, A4-size, and envelope cassettes cost \$79, \$69, and \$89, respectively. Paper feeds through the front and can come out in either faceup or facedown collated order.

The printer control panel is mounted on



DEC's DEC Laser 2200 offers 6.4-page-per-minute duplex printing.

the front and includes a 16-character liquid crystal display, LED indicators, and seven flush-mounted buttons. You can change printer settings directly from the menu.

If you're a Digital Equipment Corp. computer user, both of the DEC Lasers have a lot to like, including the easily installed and maintained Canon SX engine, and built-in PostScript file-printing ability. If you're an IBM PC user, however, there's no compelling reason to even consider these printers, unless you need to share one with DEC computer users. Even then you'll have to figure out a way to make the DEC laser work with your software.

DEC Laser 2100 and DEC Laser 2200

Digital Equipment Corp., 146 Main St., Maynard, MA 01754; (800) 344-4825, (508) 493-5111.

List Price: \$2,695 (2100); \$3,999 (2200); upgrade to 1.5MB RAM, \$495; upgrade to 2.5MB, \$990; upgrade to 3.5MB, \$1,485; PostScript option (for VAX only), \$1,001; emulation cartridge, \$399; font cartridges, \$299-\$399; legal-sized paper cassette, \$79; A4-size paper cassette, \$69; envelope cassette, \$89; optional printer stand, \$299.

Standard Warranty: One year on parts and labor. **Dimensions (HWD):** 9 x 17.8 x 24.8 in. (2100); 12.5 x 17.8 x 32 in. (2200). **Weight:** 47 lbs. (2100); 69 lbs. (2200).

Emulations: DEC LN03. **In Short:** These 8-ppm Canon SX engine-based printers currently are of limited utility in IBM PC environments. The only standard emulation is an ANSI-compatible code setting—an upcoming PostScript emulation cartridge isn't ready yet. Best for DEC users; others should look elsewhere.

CIRCLE 611 ON READER SERVICE CARD

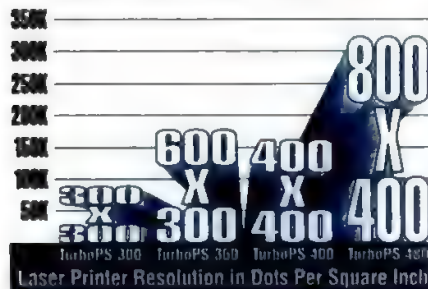
Let NewGen satisfy your hunger for high-resolution with an affordable 800 dpi printer!

Text for the menu was created in PageMaker, saved as EPS files and placed in FreeHand.

Add powerful applications like PageMaker®, FreeHand® and Adobe® Type Fonts to produce typeset quality output at your own facility.

The NewGen TurboPS/480 can produce PostScript® language compatible output at 800 x 400 dpi, nearly four times the resolution of other laser printers. And when we say PostScript compatible, we mean it, including Type 1 fonts, special effects and EPS files from all your favorite applications and programs.

The NewGen TurboPS/480 is a complete printer with built-in AppleTalk®, parallel and serial ports. And unlike some printers, it works in mixed Mac-PC



The Images with Impact® clip art illustrations were edited with FreeHand and color was specified in cyan, yellow, magenta and black.

The Apollo logo was created in FreeHand where the various elements were edited and combined.

Resolution close up, 18 point Garamond Italic enlarged 500%



300 x 300 dpi LaserWriter II
800 x 400 dpi NewGen PS/480
600 x 600 dpi Varityper VT-600

environments, and it doesn't require an internal PC processing board or dedicated server.

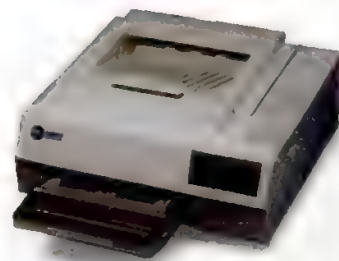
To show you how confident we are that you'll be impressed with 800 x 400 dpi output, we printed this page at actual size, including the menu which was output as color separations.

What does all this resolution and compatibility cost? Very little. The TurboPS/480 - with 800 x 400 dpi and RISC performance - lists for about 25% to 50% less than its competitors, while our TurboPS/400, TurboPS/360 and

TurboPS/300 laser printers cost less than slower 300 and 400 dpi PostScript language printers.

If you have an appetite for high-speed, high-resolution PostScript language printing, call 714/641-8900 today to get your TurboPS evaluation kit.

Dealer inquiries welcome.



This ad was created and separated on a TurboPS printer. For information about its production, contact NewGen Corporation.



NewGen Systems Corporation™

17580 Newhope Street, Fountain Valley, CA 92708
Telephone (714) 641-8900 FAX (714) 641-2800

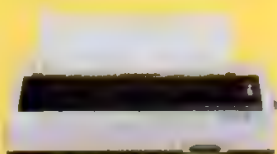
CIRCLE 220 ON READER SERVICE CARD

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Seikosha SP-2000 Plus: Up to 240 cps,
4 Resident Fonts, Push Tractor with Paper Parking



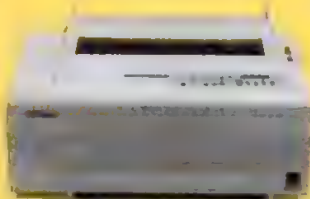
Seikosha SL-230: 277 cps, 24-pin,
Front-loading Function Card; 9 Resident Fonts,
Push Tractor with Paper Parking



Seikosha SK-3005 Plus: 300 cps, Epson/IBM
Proprinter III XL Emulations with Color,
2 Resident Fonts



Seikosha BP-5460: 460 cps, IBM Epson
Emulations, Parallel/Serial Interfaces



Seikosha SBP-10: 800 cps, DEC IBM/Epson
Emulations, Parallel/Serial/Trinmax/Coax
Interfaces

**Serious printers
for serious business.**

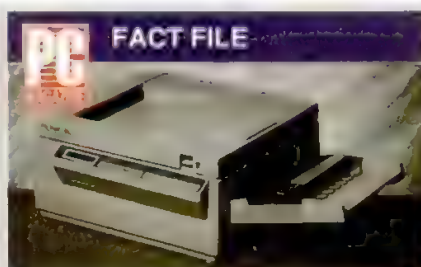
PRINTERS

LASERS

three reviewed five months ago (see "A \$1,000 Laser for Every Desktop," June 12, 1990): the Facit P6060 (also reviewed here), the Epson EPL 6000, and the Toshiba PageLaser6 (also reviewed here). Then take a look at the 6-ppm PB9500 from Packard Bell Electronics. You'll be hard-pressed to find any differences beyond the company and model name.

The similarities between those inexpensive printers and the PB9500 do not extend to price. The PB9500's list price is \$2,195, about \$500 more than the most expensive of its near twins. Packard Bell estimates the street price for the PB9500 will fall between \$1,199 and \$1,499, which is considerably higher than the street prices for its matching printers. However, the higher price does include an extra 1MB of RAM, for a total of 1.5MB—in most other ways the PB9500 matches the other printers point for point.

The 35-pound PB9500 measures 8 by 24.8 by 15.5 (HWD) inches complete with paper tray. To set up the printer, you must install a separate drum unit, developing unit, and toner cartridge. Assembling the consumables is more difficult than installing an all-in-one cartridge, but not enough to be a problem. More serious is the exposed drum, which means that you'll need to exercise caution during installation.



Packard Bell PB9500

Packard Bell Electronics Inc., 9425 Canoga Ave., Chatsworth, CA 91311; (818) 773-4400.

List Price: \$2,195; upgrade to 2.5MB RAM, \$995; upgrade to 4.5MB, \$1,950; optional emulation cartridges, \$229 each; font cartridges, \$229 each; optional faceup output tray, \$30.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 8 x 24.8 x 15.5 in.
Weight: 35.3 lbs.

Emulations: HP LaserJet Series II.

In Short: The Packard Bell PB9500 is more expensive than the other virtually indistinguishable 6-ppm TEC engine-based lasers reviewed here, in part because of its 1.5MB base memory.

CIRCLE 422 ON READER SERVICE CARD

Aside from loading consumables, setup consists of filling the 150-sheet paper tray and plugging in a power cord and cable. For those who need it, the printer comes with a serial port that can be set as RS-232

The Packard Bell PB9500 comes with a serial port that can be set as RS-232 or RS-422. But it's much easier to use the parallel port, and Packard Bell includes a parallel cable with the unit.

or RS-422. However, in most cases it's easier to use the parallel port, and Packard Bell thoughtfully includes a parallel cable with the printer.

The PB9500's front panel includes an on-line/off-line toggle, a manual feed control, and a thick-paper control (28-pound weight and over). In addition, you'll find a form-feed button that doubles as a reset button, and four menu selection controls that help make the LCD menus easy to use. The manual is heavily illustrated and generally clear.

On PC Labs' tests, the PB9500's performance matched that of its near twins. Under LaserJet Series II emulation the printer managed 5.7 ppm for text and 1.1 gppm for graphics—the same as the Facit P6060, Epson EPL 6000, and Toshiba PageLaser6. Output quality displayed crisp text, and solid, dense blacks in graphics. The gray-scale and scanned photo images retained the appropriate level of detail, and the printer handled the LaserJet Series II emulation test easily.

If you have some ancient programs that can't communicate with a LaserJet, Packard Bell offers three cartridges that will let you add Epson FX, IBM Proprinter, or Diablo 630 emulation, at \$229 per cartridge. These plug into either of two slots on the side of the printer.

According to Packard Bell, the slots will also accept most font cartridges meant for HP printers. However, the company does not sell any of its own. Built-in fonts are limited to Courier, Courier Bold, and

PRINTERS LASERS

Line Printer, all in portrait and landscape. Packard Bell says that the printer can also accept LaserJet-compatible downloadable fonts.

The only other options for the PB9500 are RAM cards and a \$30 faceup output tray for the straight-through paper path for heavy stock. As already mentioned, the printer comes with 1.5MB of RAM, which is divided between 512K in the base printer and a 1MB board. Adding more RAM means replacing the board. An upgrade to 2.5MB costs \$995, and an upgrade to 4.5MB costs \$1,950.

Ultimately, the extra 1MB of RAM serves as the argument both for and against choosing the PB9500 over similar TEC 1305-based printers. If 1.5MB is the right memory size for your needs, the price makes sense, if not it's a waste of money and you should look elsewhere.

Panasonic KX-P4420 Laser Partner

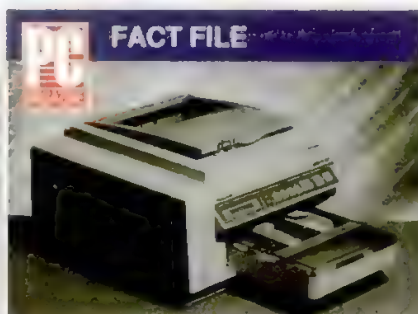
by M. David Stone

The KX-P4420 Laser Partner from Panasonic Industrial Co. meets almost all the requirements of a low-end laser printer. Not only is it the least expensive laser printer in Panasonic's line, it offers high-quality output, LaserJet Series II emulation, a list price of \$1,695, and an estimated street price of \$925. But, it offers better than low-end laser speed.

The most unique feature of the KX-P4420, and the one that makes it stand out from the crowd of low-end lasers, is its 8-ppm Matsushita Electric Corp. KX-P4420 engine. On PC Labs' tests, that translates to 7.4 ppm for text and 1.8 gppm for graphics, which simply blows away all those 4- and 6-ppm printers that

sell for approximately the same price.

Panasonic is a division of Matsushita Electric Corp., which explains why the engine and the printer share the same model number. It also explains why you won't see this engine in a lot of other printers. Yet, in many ways, the design of



FACT FILE

Panasonic KX-P4420 Laser Partner
Panasonic Industrial Co., Office Automation Group, Two Panasonic Way, Secaucus, NJ 07094; (800) 742-8086, (201) 348-7000.
List Price: \$1,695; upgrade to 1.5MB RAM, \$495; upgrade to 2.5MB, \$945; upgrade to 4.5MB, \$1,890; font cards, \$145 each; optional envelope cassette, \$85; optional legal cassette, \$59; optional serial port, \$139.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 10.5 x 16.8 x 24.3 in.
Weight: 45.2 lbs.
Emulations: HP LaserJet Series II.
In Short: A low-end laser in price only, the KX-P4420 is based on an 8-ppm engine. PC Labs tests uncovered a minor incompatibility with the LaserJet Series II emulation, but once Panasonic fixes this problem, this laser will be a clear winner.

CIRCLE 423 ON READER SERVICE CARD

this 45-pound, 10.5- by 16.8- by 24.3-inch (HWD) printer is standard fare.

Like most laser printers, the KX-P4420 has a manual feed on the paper tray, an output bin in the top of the printer for face-down collating, and an alternate, straight-through paper path for heavy stock—a bonus is the 250-sheet capacity of the paper tray. In addition, an \$85 envelope cassette and a \$59 legal-size paper cassette are available.

The KX-P4420 uses a separate drum unit, developer unit, and toner cartridge. As with all printers that use separate consumables rather than an all-in-one cartridge, this leaves plenty of opportunity for damaging the drum or spilling the toner.

The front panel on the KX-P4420 has a 16-character LCD display and seven membrane switches. These include an on-line key, form-feed key, and five keys dedicated to the printer menu. The five

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FONTS & FEATURES															
Panasonic KX-P4420 Laser Partner															
HP LaserJet Series II															
Helvetica				Times				Courier				Line Printer			
Underline	Sub	Italic	Bold	Underline	Sub	Italic	Bold	Underline	Sub	Italic	Bold	Underline	Sub	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															

PRINTERS LASERS

Panasonic KX-P4450i Laser Partner

by M. David Stone

menu keys are used for entering or exiting the menus, entering changes, and for navigating your way through the menu choices displayed on the LCD panel.

The menu structure is far from intuitive, but if you're familiar with printers, you can find the options with a little work. And the manual covers everything you need to know.

The KX-P4420 fared well on PC Labs' tests, with one exception: On the LaserJet compatibility test, the unit choked on the zero-byte image, repositioning to the top of the page so that the bottom third of the page printed over the top third. Panasonic has confirmed the problem and is taking steps to fix it. A company representative claims that once the problem is solved, any owner who requests a ROM with the fix will receive one free. Check with Panasonic for the proper ROM version.

Otherwise, the KX-P4420 produces superb output, with crisp, dark text and smooth, solid black areas in graphics. The PC Labs' gray-scale and scanned photo images retained the appropriate level of detail when printed under LaserJet Series II emulation.

A noteworthy touch is the addition of several fonts to the LaserJet Series II emulation. The KX-P4420 includes Courier, Courier 12-pitch, and a proportionally spaced Century, all in standard, bold, and italic fonts. Courier 16.66-pitch in standard and italic fonts is also available. All are available in portrait and landscape, but there is no Line Printer font. The printer also has two slots for font cards, which cost \$145 each, and it can accept downloadable fonts—but not font cartridges—meant for the LaserJet.

The only other printer options are a \$139 serial port and RAM upgrades. You can add a 1MB board for \$495 and one or two 2MB boards for \$945 each, for a maximum of 4.5MB RAM. By the time this article is published, Panasonic also expects to have optional IBM Proprinter, Diablo 630, and Epson FX emulations available in firmware to go on the system board.

Clearly, the KX-P4420 is a high-powered printer with a low-end price. The incompatibility problem we uncovered may make you hesitant if you print a lot of graphics, but you're not likely to run into it often. Even with this minor incompatibility, the KX-P4420 is worth considering. Once Panasonic fixes the problem, there will be little reason to buy a slower printer at the same price.

The \$2,095 Panasonic KX-P4450i Laser Partner is the 11-ppm, dual-bin, big brother to the KX-P4420. Like its smaller sibling, the 14.3-by 27-by 16-inch (HWD) KX-P4450i is built around a Matsushita Electric Corp. engine that bears the same basic model name as the printer, in this case, the KX-P4450.

The KX-P4450i is an updated version of the KX-P4450, which we reviewed two years ago (see "Laser Printers: Another Year Older, Another Year Wiser," October 31, 1988). The new model differs from the old one in only a few ways. Probably the most significant change is that the 66-pound KX-P4450i Laser Partner emulates the LaserJet Series II rather than the LaserJet Plus, and just to make sure the printer will work with most programs, Panasonic has included the IBM Proprinter, Epson FX, and Diablo 630 emulations as well.

If you like command panels with plenty

FONTS & FEATURES												
Panasonic KX-P4450i Laser Partner												
HP LaserJet Series II												
	Helvetica			Times			Courier			Line Printer		
	Underline	Sub Super	Italic	Underline	Sub Super	Italic	Underline	Sub Super	Italic	Underline	Sub Super	Italic
8/9-point												
10-point												
12-point												
14-point												
Scalable												
IBM Proprinter												
	Bold		Italic	Sub-Super		Underline						
10 cpi												
12 cpi												
Compressed												
Proportional												

of buttons, you'll love the front panel on this printer. Twelve membrane switches plus a 16-character LCD panel offer control over fonts, interface settings, emulations, number of copies to print, and orientation. The switches are all clearly labeled, and their functions are easy to understand. Even so, laser novices will appreciate the heavily illustrated manual. Advanced users will appreciate the

information on the control codes for each particular emulation.

On the text speed tests, the Laser Partner managed 10.2 ppm in LaserJet emulation mode and 9.7 ppm in Proprinter mode, making it among the fastest in its price range for text. Graphics speed was not as impressive; 1.8 gppm in LaserJet Series II mode and 2.1 gppm in 9-pin Proprinter mode. For comparison, the IBM Laser-Printer, with a 10-ppm engine, scores about 9 ppm for text and 1.7 gppm for graphics

**The KX-P4450i Laser
Partner managed 10.2
ppm in LaserJet
emulation mode and 9.7
ppm in IBM Proprinter
mode, making it among
the fastest in its price
range for text.**

in LaserJet Series II emulation. But it manages 2.8 gppm in IBM graphics speed.

The quality of the Laser Partner's output is beyond reproach. Text characters are dark and crisp, and black areas in graphics are solid and dense. The Laser Partner printed our sample gray-scale and scanned photographic images with the appropriate levels of detail under each emulation.

The KX-P4450i improves on the LaserJet Series II font choices by including Courier, Courier 12-pitch, and proportionally spaced Century in standard, bold, and italic fonts, and Courier 16.66-pitch in standard and italic. In addition, it adds Courier 15-pitch in standard and italic fonts. All fonts are available in both portrait and landscape orientation. And like the KX-P4420, the KX-P4450i includes two slots for font cards, at \$145 for each card, and it can accept downloadable fonts for the LaserJet.

Unfortunately, the KX-P4450i also shares the KX-P4420's problem with handling the zero-byte image on the PC Labs' PCL test. Here too, the printer responded by repositioning to the top of the page, so that the bottom third of the page printed over the top third. A Panasonic

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CIRCLE 297 ON READER SERVICE CARD

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representative says that once the problem is solved, anyone who requests a ROM with the fix will receive one free of charge. Again, check with Panasonic for the proper ROM version.

The Laser Partner's paper-handling features are a mixed blessing. The unit's two paper trays—one of which includes a convenient manual feed slot—can easily hold a full 500 sheets between them. But the only output choice is the face-down bin located at the top of the printer. Notable for its absence is a straight-through path for heavy-weight paper or cardboard stock.

Moreover, another less-than-ideal design choice is a toner hopper that needs to be filled from a bottle. Squinting the toner into the hopper while waving the



Panasonic KX-P4450i Laser Partner
Panasonic Industrial Co., Office Automation Group, Two Panasonic Way, Secaucus, NJ 07094; (800) 742-8086, (201) 348-7000.
List Price: \$2,095; upgrade to 1.5MB RAM, \$495; upgrade to 2.5MB, \$945; upgrade to 4.5MB, \$1,890; font cards, \$145 each; optional envelope cassette, \$85; optional legal cassette, \$59.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 14.3 x 27 x 16 in.
Weight: 66.8 lbs.
Emulations: HP LaserJet Series II, IBM Proprinter, Epson FX, Diablo 630, Panasonic KX-P1180.
In Short: The Panasonic KX-P4450i Laser Partner is the 11-page-per-minute, dual-bin, big brother to the company's 8-ppm KX-P4420 printer. Produces lots of attractive text on standard paper. Notable for its absence is a straight-through paper path.

CIRCLE 424 ON READER SERVICE CARD

bottle back and forth is a good way to get toner into the air, your lungs, and on your desk. As you might expect, the engine also uses separate drum and developer units.

The options available for the KX-

PRINTERS LASERS

P4450i are largely the same as for the KX-P4420. You can add a 1MB board for \$495, and one or two 2MB boards for \$945 each, for a maximum of 4.5MB of memory in the printer. An \$85 envelope tray and a \$59 legal-size paper cassette are also available from Panasonic. A serial port is one of the KX-P4450i's standard features.

The value of this printer depends very much on what you want to use it for. If you're looking for a way to pump out lots of attractive text on standard paper, the high speed, 500-page capacity, and \$1,300 street price make the KX-P4450 a good, solid choice. But if you need to print on heavy-weight paper or cardboard stock, or insist on maximum setup ease and maintenance, you're best advised to look elsewhere.



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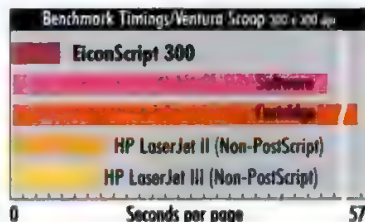
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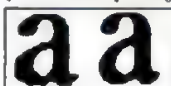
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EICON
TECHNOLOGY

Printware 720 IQ Professional II

by David Dean

When we last reviewed the Printware 720 IQ Professional II with the 1200HD Image Processor (see "Lasers: A New Standard," November 10, 1987), we praised the 1,200- by 600-dot-per-inch printer for its razor-sharp, near-typeset-quality output, but noted that it did not offer PostScript or HP LaserJet compatibility. Three years and two generations later, the Printware 720 IQ Professional II still produces stunning text and graphics and still lacks HP emulation, but now it supports PostScript-compatible Type 1 and Type 3 fonts, prints text faster, includes a more-powerful microprocessor, and at \$11,990 costs almost \$1000 less than the original.

Designed to handle high-volume, high-end desktop publishing jobs that might normally be sent out to a service bureau, the two-piece 108-pound Printware 720 IQ is hardly your typical desktop printer. Not only will you need a strong table to support this heavyweight, you'll need a service engineer to install and maintain it. (By the time this article is published, Printware will be shipping a user-installable model.) You'll also need about

three feet of counter space, if you plan to place the 720 IQ's two components—a 6.5- by 21- by 16.5-inch (HWD) ZipRip image processor and a 12- by 36- by 19.5-inch (HWD) laser printer—side by side. Stacking the printer atop the image processor's AT-style case is a more practical solution.

The 720 IQ's Printware-manufactured engine, which incorporates a patented

FONTS & FEATURES															
Printware 720 IQ Professional II															
PostScript emulator															
Helvetica				Times				Courier				Line Printer			
Underline	Sub	Super	Italic	Underline	Sub	Super	Italic	Underline	Sub	Super	Italic	Underline	Sub	Super	Italic
Bold				Bold				Bold				Bold			
8.9-point															
10-point															
12-point															
14-point															
Scalable															

3M vibrating mirror, has an expected life of 1.2 million pages and a rated monthly duty cycle of 2,000 pages, and requires maintenance every 40,000 pages. Its drum is rated to last for 100,000 pages. According to Printware, if you print 20,000 pages per month, your printing costs will be approximately \$.03 per page over five years, including purchase price, maintenance, and consumables. So, if you're spending more than \$600 per month on service bureau fees, it may be worth your while to consider the 720 IQ.

The printer is housed in the casing of a Toshiba copier and uses an improved version of Toshiba's straight-through paper-handling system. A 250-sheet paper tray feeds letter- or legal-sized sheets to the printer, which delivers them to the exit tray in reverse order. Tucked away in the Toshiba shell are two toner bays, the second of which you can use for spot color. (We were unable to test this latter option during review, however it should be available by the time you read this.) Apparently, you must pass the paper through twice to add color to an original, since only one toner bay can be active at a time. For regular black-on-white printing, Printware requires that you use its smaller-particle 9-micron toner, which costs \$156 for a kit of four 250 mg. bottles; for spot color printing, the company offers red, blue, and brown toner for \$32 per 250 mg. bottle.

You connect the printer to the ZipRip image processor, which is really a fully functional computer, with a motherboard, a Motorola 68030 microprocessor, 4MB of RAM, a 20MB hard disk, and three empty slots, via a 50-pin parallel cable. (An earlier version of the image processor used two Motorola 68000 CPUs.) A red indicator light on the image processor flashes when the hard disk is active, and a green light flashes when the image processor is ready to receive data and stops flashing when it is receiving and processing data. A busy button on the printer's control panel (which is also home for a one-character LED display, 14 indicator lights, and three other buttons) indicates that the engine is printing. The 720 IQ also has one parallel, one AppleTalk, and two serial ports, although one serial port is for diagnostics only and cannot be used for printing.

The ZipRip image processor is responsible for producing beautiful half-tones. That's because, in addition to supporting 64 levels of gray, the Printware 720 IQ offers true addressable 1,200- by 600-dpi resolution, which means that all 720,000 dots per square inch can be controlled by the image processor. On top of this, the ZipRip lets you select any number of lines between 30 and 150 in your half-tone screen and also rotate the digital mesh to any point between 0 and 90 degrees, affording you even more control over your half-tones.

Residing on the image processor's hard disk are 35 PostScript width-compatible typeface outlines, all of which you can scale from 4 to 720 points. Although these Bitstream typefaces match those of the Apple LaserWriter and most other PostScript printers, they've been converted to work optimally with *Printstyle*, Printware's proprietary PostScript emulator.

Printware sells an additional 250-plus converted Bitstream typefaces in 62 packages, each priced at \$149. You can download these typefaces as needed or store them on the image processor's hard disk. You can also download or store PostScript-compatible Type 1 or Type 3 PostScript outlines on the image processor's hard disk. However, the 720 IQ will not scale non-Printware-format PostScript typefaces as quickly as it does converted Printware typeface outlines. Printware does not supply screen fonts for its typefaces.

In testing, the Printware 720 IQ per-



Printware 720 IQ Professional II

Printware Inc., 1385 Mendota Heights Rd., St. Paul, MN 55120; (800) 456-1400, (612) 456-1400.

List Price: \$11,990; upgrade to 8MB RAM, \$1,990; font packages, \$149 each.

Standard Warranty: 90 days on parts and labor.

Dimensions (HWD): 18.3 x 35 x 21 in.

Weight: 108 lbs.

Emulations: PostScript emulator, Apple LaserWriter II.

In Short: The 720 IQ offers fully addressable 1200-by-600 dpi resolution. Its crisp, camera-ready text and user-settable halftones as well as PostScript emulation and 35 resident fonts make it a clear network contender.

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PRINTERS LASERS

formed well. It churned out our test image at a rate of 0.6 gppm, placing it in the middle of the PostScript printers reviewed here. With a text speed result of 7.5 ppm, the 720 IQ performed comparably to the other 8-ppm lasers in this roundup. And the printer handled our PostScript test with no problem.

With its respectable performance and stunning output, the Printware 720 IQ goes one step further in transforming the idea of desktop publishing into practice. For those of us who have had to settle for 300-dpi masters or had to proof look-alike copy, the Printware 720 IQ offers a chance at standalone production of the genuine article.

Qume CrystalPrint Express

by Bruce Brown

The CrystalPrint Express is the very top of Qume Corp.'s CrystalPrint page-printer line. But unlike Qume's three other page printers, the Express doesn't use a Casio liquid crystal shutter engine. Instead, the \$5,595 CrystalPrint Express employs a 12-ppm Sanyo SPX-612 dual-mode engine, which gives you a higher resolu-

tion, 600- by 300-dot-per-inch mode for jobs that demand better-than-average output.

Of course, you probably won't pay list price for this 66-pound, 14.5-by-16.5-by-18.5-inch (HWD) printer. For a \$4,200 street price, you'll get a choice of two resolutions, 3MB of RAM, a parallel and serial port, two paper trays—each capable of holding 250 sheets of letter-size paper—and the same emulations included in Qume's CrystalPrint Publisher II page printer: PostScript via a modified RIPS PostScript-compatible chip set, Network PostScript for software-controlled printer mode shifting, and HP LaserJet Series II. Like the Publisher II, the Express gives you access to 39 scalable fonts, including PostScript Type 1 fonts. You can scale and rotate 35 fonts in HP mode, but these capabilities aren't available through Network PostScript.

If 3MB of RAM isn't enough, you can increase the memory to 8MB using dealer-installed industry-standard 1MB SIMMs. An upgrade to 4MB from Qume costs \$495; to 5MB, \$990; to 6MB, \$1,485; to 7MB, \$1,980; and to 8MB, \$2,475. You can also buy a 6MB version of the Express for \$6,590.

Whether you decide to go with the 6MB version or have your dealer install more memory, you'll want at least 6MB of RAM if you're going to activate the two-page buffer for use with the Express' 600- by 300-dot-per-inch mode; without it you'll have to wait a long time for your output. You can switch from 300- by 300-dpi mode to 600- by 300-dpi mode by selecting from a menu which is displayed on the control panel of the printer in a one-line 16-character LCD screen. A step up from the other CrystalPrint models, the Express's control panel also features lights and membrane switches.

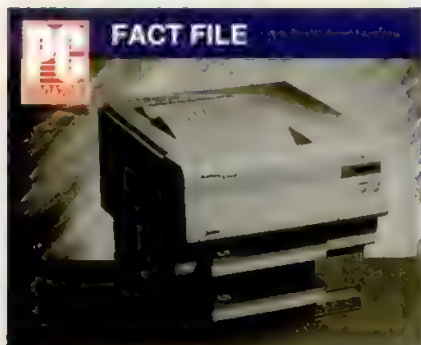
The Express' Sanyo laser engine has a rated life of 600,000 copies and a monthly duty cycle of 10,000 copies. Toner cartridges cost \$27, come in a case of four, and each one is good for about 3,000 sheets. The other consumable is a \$327 imaging kit (one comes with the printer), which includes a developer drum, an OPC cartridge, and two toner cartridges. Installing the pieces isn't terribly difficult, but if you're not reasonably careful, you could bend some of the parts or spill toner.

Paper can come out of the printer in

either faceup or facedown collated order. In addition, you can feed envelopes or single sheets of cardboard stock manually.

In PostScript mode, the CrystalPrint Express's speeds on the PC Labs text and graphics tests were problematic. The Express printed the PostScript test graphics and text beautifully, but very slowly: 0.8 gppm for graphics and 2.6 ppm for text. Noting that the PostScript-emula-

FONTS & FEATURES															
Qume CrystalPrint Express															
PostScript emulator															
Helvetica				Times				Courier				Line Printer			
Underline	Sub/Sup	Italic	Bold	Underline	Sub/Sup	Italic	Bold	Underline	Sub/Sup	Italic	Bold	Underline	Sub/Sup	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															
HP LaserJet Series II															
Helvetica				Times				Courier				Line Printer			
Underline	Sub/Sup	Italic	Bold	Underline	Sub/Sup	Italic	Bold	Underline	Sub/Sup	Italic	Bold	Underline	Sub/Sup	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															



FACT FILE

Qume CrystalPrint Express
Qume Corp., 500 Yosemite Dr., Milpitas, CA 95035; (800) 223-2479, (408) 942-4000.
List Price: \$5,595; upgrade to 4MB RAM, \$495; upgrade to 5MB, \$990; upgrade to 6MB, \$1,485; upgrade to 7MB, \$1,980; upgrade to 8MB, \$2,475.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 14.5 x 16.5 x 18.5 in.
Weight: 66 lbs.
Emulations: PostScript emulator, HP LaserJet Series II.
In Short: Qume's new 12-ppm laser comes with two paper trays, a PostScript emulator, and a high-resolution mode. An undetermined bug slowed down text printing in PostScript mode, but otherwise, this fast, flexible printer offers lots of power at a competitive price.

CIRCLE 429 ON READER SERVICE CARD

tion firmware in this printer is "99 percent" the same as the code in its Publisher II printer, a 6-ppm printer that printed at 0.5 gppm for graphics and 5.2 ppm for text, Qume was at a loss to explain why the Express's PostScript text speed was so slow.

The printer's speeds under HP LaserJet emulation—2.5 gppm for graphics and 9.9 ppm for text—indicate that the CrystalPrint Express is indeed a fairly fast printer. You should note that we tested one of the first printers available after the model's release in late July, and that Qume is working assiduously to find the cause of the speed problem, which had not happened in its own tests.

This speed problem notwithstanding, the Express worked fine in both PostScript and HP LaserJet modes. As is the case with many printers in PostScript emulation mode, the Express didn't print a PostScript status page (it prints its own on power-up or reset). And while the Express printed the content of the test document correctly, it printed a macro-driven header in landscape rather than in



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portrait orientation. This too is not unusual, since PostScript emulators often have problems with other program's headers.

With its dual-resolution engine, dual paper trays, standalone and Network PostScript, HP LaserJet Series II emulations, and plethora of scalable and rotatable fonts in both compatibility modes, the CrystalPrint Express is going to be a competitive printer. Once Qume irons out the Express's speed problem, the unit will warrant a hearty recommendation as a fast, full-featured and flexible printer for business and desktop publishing applications.

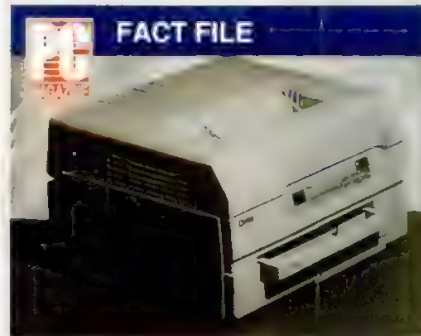
Qume CrystalPrint Publisher II

by Bruce Brown

Second from the top in Qume Corp.'s page printer series is the \$3,995 CrystalPrint Publisher II, a 6-ppm model that uses the same Casio liquid crystal shutter 300-dot-per-inch engine you'll find in the lower-priced CrystalPrint Series II and CrystalPrint Super Series II. An aggressive street price (typically \$2,500 to \$2,600), 2MB of RAM expandable to 6MB, three print modes—PostScript, Network PostScript, and HP LaserJet Series II—39 scalable and rotatable Type 1 fonts in PostScript mode, and 35 scalable fonts in HP mode make the Pub-

lisher II printer a strong contender.

The 35-pound Publisher II uses the same 9.3-by 15.5-by 14.3-inch (HWD) case as the CrystalPrint Series II and Super Series II. Both parallel and serial



Qume CrystalPrint Publisher II
Qume Corp., 500 Yosemite Dr., Milpitas, CA 95035; (800) 223-2479, (408) 942-4000.
List Price: \$3,995; upgrade to 4MB RAM, \$495; upgrade to 5MB, \$990; upgrade to 6MB, \$1,485; downloadable fonts, \$100-\$150.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 9.3 x 15.5 x 14.3 in.

Weight: 35 lbs.

Emulations: PostScript emulator, HP LaserJet Series II.

In Short: The CrystalPrint Publisher II adds a PostScript emulator to Qume's 6-ppm LCS engine line. Aggressive pricing and solid performance means the user wins.

CIRCLE 542 ON READER SERVICE CARD

ports are standard, as is an AppleTalk serial interface.

The printer's Casio liquid crystal shutter engine has a rated life of 300,000 sheets and a monthly duty load of 5,000 sheets. The unit uses separate consumables—a \$125 toner cartridge that's good for 7,500 sheets and a \$260 drum developer kit that lasts for 20,000 sheets.

Although you can expand the Publisher II's memory to 6MB, you don't have to buy memory upgrades from Qume because the printer uses industry-standard SIMMs. (Qume offers an upgrade to 4MB for \$495; 5MB for \$990; and 6MB for \$1,485.) But even if you buy your own memory (and possibly save a considerable amount of money in the process), you probably shouldn't try to install it yourself since it involves taking apart a multilayer controller board inside the printer. The job is one for your dealer.

With all of the Publisher II's resident fonts, you probably will have little need for extra fonts. But you can use HP LaserJet-compatible soft fonts if you wish.

Qume sells downloadable fonts at prices ranging from \$100 to \$150.

The Publisher II has one paper tray, a 100-sheet unit that handles letter-, legal-, and A4-size paper. You can feed envelopes or heavy stock manually from the rear of the printer.

The printer's control panel includes a two-character LED display, six LED indicators, and five membrane buttons. Most functions, including menu setup and test printing, are accessible from the panel. The excellent documentation provides helpful instruction and reference, including information on using the Publisher II with Apple computers.

Under HP LaserJet Series II emulation, the Publisher II completed the PC Labs' graphics speed test at a rate of 1.8 gppm. The printer completed the same test in PostScript mode at a rate of 0.5 gppm, but produced far superior output; the wait is worthwhile. On the PC Labs' text speed tests, the printer's speeds were 6 ppm in LaserJet mode and 5.2 ppm in PostScript mode.

The Publisher II passed both our HP LaserJet and PostScript compatibility tests. Since PostScript is the printer's default mode, you can access scalable and fully rotatable fonts even while the printer is running in HP-compatible mode. This capability is possible, because of the custom programming Qume has added to the RIPS PostScript-compatible chip set.

Network PostScript mode lets you change printer modes by software command only. Under Network PostScript you cannot use the Publisher II's native scalable fonts when you switch to HP mode.

If you need medium-speed laser printing for desktop publishing and typical business applications, consider the CrystalPrint Publisher II. With a standard 2MB RAM, lots of scalable and rotatable fonts in both PostScript and HP modes, a Network PostScript mode, and 6-ppm performance in text mode, the Publisher II is a strong choice, especially if you can get one for around \$2,500.

Qume CrystalPrint Series II

by Bruce Brown

Of the four CrystalPrint page printers that Qume Corp. sells, the 300-dot-per-inch CrystalPrint Series II is the least-

Fonts & Features

Qume CrystalPrint Publisher II

PostScript emulator

	Helvetica	Times	Courier	Line Printer
Underline				
Sub-Super				
Italic				
Bold				
8/9-point				
10-point				
12-point				
14-point				
Scalable				

HP LaserJet Series II

	Helvetica	Times	Courier	Line Printer
Underline				
Sub-Super				
Italic				
Bold				
8/9-point				
10-point				
12-point				
14-point				
Scalable				

PRINTERS **LASERS**



Qume CrystalPrint Series II
Qume Corp., 500 Yosemite Dr., Milpitas, CA 95035; (800) 223-2479, (408) 942-4000.
List Price: \$1,499; upgrade to 1.5MB RAM, \$399; emulation cartridges, \$139 each; PostScript option, \$1,999; font cartridges, \$139-\$279; downloadable fonts, \$100-\$150.
Standard Warranty: One year on parts and labor.

Dimensions (HWD): 9.3 x 15.5 x 14.3 in.
Weight: 35 lbs.

Emulations: HP LaserJet Series II.

In Short: Qume's least expensive model, the 6-ppm LCS-based CrystalPrint Series II offers a good bargain if you're looking for a personal laser printer, although paper handling capabilities are limited.

CIRCLE 543 ON READER SERVICE CARD

equipped, and at \$1,499, the least expensive. When we first saw this printer in our 1988 printer blockbuster ("Laser Printers: Another Year Older, Another Year Wiser," October 31, 1988), its list price was \$500 more than it is now. Today, you should be able to find the CrystalPrint Series II at approximately \$1,000 on the street, which is a good deal for this solid HP LaserJet Series II-compatible printer with 512K of memory and parallel and serial ports.

More a personal printer than an office powerhouse, the 35-pound, 9.3-by 15.5-by 14.3-inch (HWD) CrystalPrint Series II is rated at 6 ppm, but performs faster than that. On the PC Labs' text speed test the unit printed at 6.5 ppm under HP LaserJet Series II emulation, consistent with the vendor's belief that the Casio liquid crystal shutter engine is faster than its rating. On our graphics speed test, the printer came in at 1.7 gppm under LaserJet Series II emulation.

The liquid crystal shutter engine has a rated life of 300,000 sheets and a monthly duty cycle of 5,000 sheets. Consumables consist of a toner cartridge, which costs \$125 and is good for 7,500 copies, and an OPC drum, which costs \$260 and is good for 20,000 copies. Installing the consumables is a two-step process that isn't

much of a challenge, but also isn't as foolproof as installing an all-in-one cartridge.

The CrystalPrint Series II performed beautifully on PC Labs' HP LaserJet Series II compatibility tests, printing the emulation test sheet as clearly as the HP printer. With Qume's \$1,999 PostScript option (which is \$500 more than the printer itself), you can add PostScript compatibility to the CrystalPrint Series II, but that's an uneconomical approach.

The CrystalPrint Series II's standard fonts are the same as those of the HP LaserJet Series II: Courier and Line Printer fonts in portrait and landscape, bold, and underlined. Qume sells ten font cartridges for \$139 to \$279 each and also sells sets

FONTS & FEATURES											
Qume CrystalPrint Series II											
HP LaserJet Series II											
	Helvetica			Times			Courier			Line Printer	
	Underline	Sub	Super	Underline	Sub	Super	Underline	Sub	Super	Underline	Sub
	Italic	Bold		Italic	Bold		Italic	Bold		Italic	Bold
8.9-point											
10-point											
12-point											
14-point											
Scalable											

of downloadable fonts for \$100 to \$150 each. The CrystalPrint Series II accepts all LaserJet-compatible downloadable fonts.

The printer's memory-expansion potential is limited to a one 1MB RAM upgrade for \$399. This limitation is an indication of the CrystalPrint Series II's position as a text and limited-graphics printer.

If the CrystalPrint Series II isn't a heavy-duty graphics printer, it also isn't a production dynamo. The printer has only a single 100-sheet cassette from which it is fed letter-, legal-, and A4-size paper.

The CrystalPrint Series II's control panel uses a two-character LED display, similar to that of the original LaserJet, and has five membrane switches and six LED indicators. Using the control panel is relatively simple, especially once you get used to the two-character abbreviations used in the LED display. The two manuals that come with the printer offer clear explanations of all of the unit's functions.

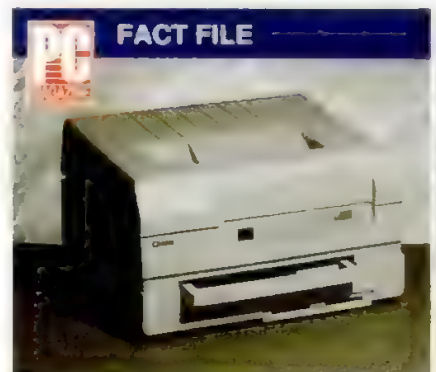
The CrystalPrint Series II isn't intended for heavy desktop publishing use or even heavy text printing. But as a faster alternative to the 4-ppm HP LaserJet IIP at about the same price, the Qume CrystalPrint Series II is a good bet as a personal printer.

Qume CrystalPrint Super Series II

by Bruce Brown

Take Qume's CrystalPrint Series II with its HP LaserJet Series II compatibility and 512K RAM, add an extra 1MB of RAM, IBM Proprinter II and HPGL plotter emulations, and a 12-pitch resident font, and increase the list price by \$500 to \$1,999. Sounds super, doesn't it (especially since the street price is only about \$1,200)? Qume Corp. must think so too, since the company calls the printer that has all these features the CrystalPrint Super Series II.

The midrange of Qume's three printers that use the 6-ppm Casio liquid crystal shutter engine, the 35-pound Super Series II has the same case as the CrystalPrint Series II, measuring 9.3 by 15.5 by



Qume CrystalPrint Super Series II
Qume Corp., 500 Yosemite Dr., Milpitas, CA 95035; (800) 223-2479, (408) 942-4000.
List Price: \$1,999; PostScript option, \$1,999; font cartridges, \$139-\$279; downloadable fonts, \$100-\$150.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 9.3 x 15.5 x 14.3 in.
Weight: 35 lbs.

Emulations: HP LaserJet Series II, HPGL, IBM Proprinter.

In Short: For \$500 more than its low-end sibling (the CrystalPrint Series II), the CrystalPrint Super Series II adds 1MB RAM, Proprinter and HPGL emulations, and a 12-pitch font. With a street price of about \$1,200, this 6-ppm printer is a great deal.

CIRCLE 544 ON READER SERVICE CARD

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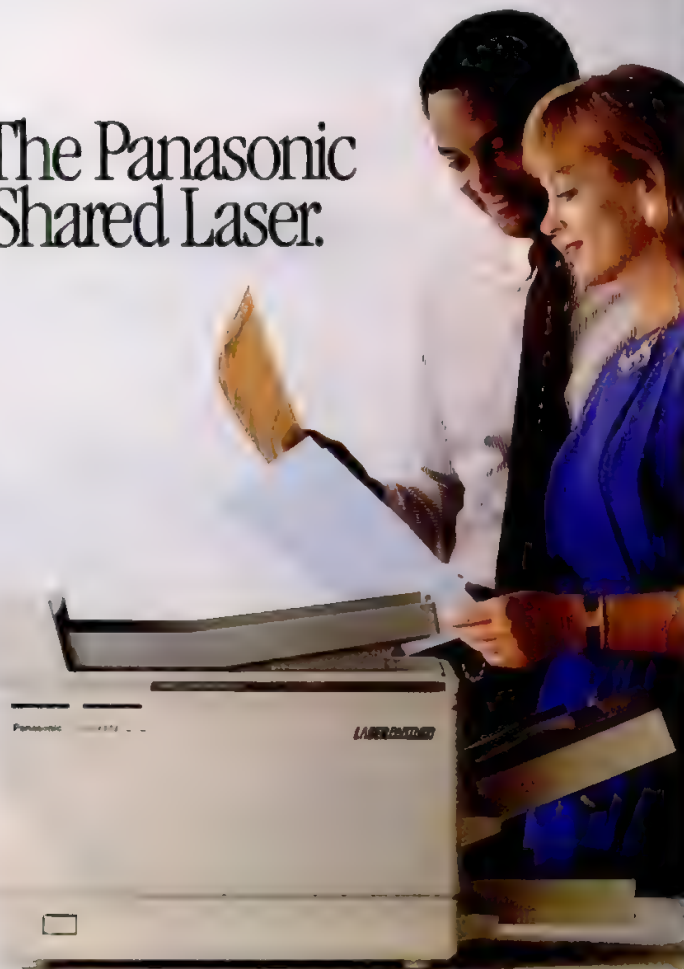
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The Panasonic PostScript Laser.



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Printing Speed: 11 pages per minute.**

Compatibility: Adobe PostScript, HP LaserJet Series II and Diablo 630 emulations.*

Fonts: 39 Adobe Fonts.*

Paper Handling: Two 250-Sheet Cassettes.

Resolution: 300 Dots Per Inch.

RAM: 2MB Standard, expandable to 4MB.

Interfaces: RS-232C/422A Serial, Centronics Parallel and Appletalk.*



The KX-P4450i

Panasonic Shared Laser.

Printing Speed: 11 pages per minute.**

Compatibility: HP LaserJet Series II, Panasonic, Epson, IBM and Diablo emulations.*

Fonts: 28 Internal Fonts-14 available in both portrait and landscape. Two slots for optional font cards.

Paper Handling: Two 250-Sheet Cassettes with Manual Feed.

Resolution: 300 Dots Per Inch.

RAM: 512K Standard, expandable to 4.5MB.

Interfaces: Centronics Parallel and RS-232C Serial.

The KX-P4420

Panasonic Personal Laser.

Printing Speed: 8 pages per minute.**

Compatibility: HP LaserJet Series II emulation.*

Fonts: 22 Internal Fonts-11 available in both portrait and landscape. Two slots for optional font cards.

Paper Handling: 250-Sheet Cassette with Manual Feed. Face-up and face-down output.

Resolution: 300 Dots Per Inch.

RAM: 512K Standard, expandable to 4.5MB.

Interfaces: Centronics Parallel; Optional RS-232C Serial.



*Printers, Computers, Peripherals,
Copiers, Typewriters and Facsimiles*

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Office Automation 

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14.3 (HWD) inches. Both parallel and serial ports are standard.

The life of the Casio engine is rated as 300,000 sheets. Toner cartridges that cost \$125 are good for 6,000 sheets and developer units, retailing for \$260 each, last for 10,000 sheets. The recommended monthly duty cycle is 5,000 sheets.

Even with the extra memory, which

FONTS & FEATURES

Qume CrystalPrint Super Series II

HP LaserJet Series II															
Helvetica				Times				Courier				Line Printer			
Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															

IBM Proprinter															
Bold				Italic				Sub/Super				Underline			
10 cpi															
12 cpi															
Compressed															
Proportional															

can work as a print buffer or hold downloadable fonts, the Super Series II is actually a bit slower at text printing than the CrystalPrint Series II, scoring exactly 6.0 ppm on the PC Labs' text speed test under both IBM Proprinter and HP LaserJet Series II emulations. While right on the rated speed, the Super Series II gives a performance bow to the 6.5 ppm tested speed of the CrystalPrint Series II. On the graphics speed test the Super Series II printed 1.6 gppm in HP LaserJet mode and 1.2 gppm in Proprinter mode. One area in which the Super Series II does not change is HP LaserJet Series II compatibility: it's exactly right.

Another area with only small improvement is the font set. In addition to the CrystalPrint Series II's Courier 10 and Line Printer fonts, the Super Series II has a 12-pitch Prestige Elite font for both portrait and landscape printing. You can use downloadable HP-compatible fonts, or purchase soft fonts directly from Qume for \$100 to \$150, or font cartridges for \$139 to \$279. The Super Series II does not allow for memory expansion—1.5MB is all you get.

Like the CrystalPrint Series II, the Super Series II also uses a single tray for letter-, legal-, and A4-size paper. The tray can hold 100 sheets, limiting the

printer's usefulness as an office powerhouse. The "S" paper feed delivers printed sheets in face-down, collated order.

The control panel on the Super Series II is the same unit used on the CrystalPrint Series II, with a two-character LED menu and status display, membrane switches, and LED indicators.

The Super Series II is a small step up from the CrystalPrint Series II in price if you can get it for just \$1,200, but it offers a significant increase in functionality.

QMS PS-410

by Alfred Poor

The QMS PS-410, one of the exciting new breed of personal laser printers, is part of the move that is driving the price of true Adobe PostScript printers to record lows. The printer is based on Canon's 4-ppm LX engine, and it lists for an attention-getting \$2,795.

The printer's most important feature is its ease of use. The PS-410 offers three different ports (parallel, serial, and AppleTalk) and two different modes (PostScript and HP LaserJet Series II.) And unlike most competing designs, it doesn't compel you to use switches to select the port or mode; all ports and modes are active all the time—even with the optional HPGL emulation card.

Automatic mode sensing is an exciting and important feature, especially in

FONTS & FEATURES

QMS PS-410

PostScript															
Helvetica				Times				Courier				Line Printer			
Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															

HP LaserJet Series II															
Helvetica				Times				Courier				Line Printer			
Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold	Underline	Sub-Super	Italic	Bold
8/9-point															
10-point															
12-point															
14-point															
Scalable															



QMS PS-410

QMS Inc., One Magnum Pass, Mobile, AL 36618; (800) 631-2692, (205) 633-7223.
List Price: \$2,795; upgrade to 3MB RAM, \$480; upgrade to 4MB, \$780; upgrade to 6MB, \$1,280; emulation card, \$295; font card, \$225; optional paper cassette with letter tray, \$195; optional legal tray, \$79; envelope tray, \$89.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 8.8 x 28.3 x 13.5 in.
Weight: 26 lbs.
Emulations: PostScript, HP LaserJet Series II.
In Short: The intelligent port management and emulation switching of the QMS PS-410 make it ideal for sharing between two or three computers. It costs a little more than some of the other new personal PostScript printers, but the extra money is worth it if you need to share one do-all machine.

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small offices or settings where two or three people need to share a printer, or where a Mac and a PC sit side by side. Plug your computer into a port and the PS-410 will pay attention when you start sending it data to print. Send it PostScript commands and it prints PostScript. Send it LaserJet commands and it prints that, too. QMS calls this "ESP" (Emulation Sensing Processor), and it sure looks like mind reading when you see it in action.

Both emulation modes were perfect on our tests. The Line Printer font is as it should be, and there is support for the PC-8 symbol set with its line-drawing characters. On the PostScript side, there is even a bonus: Instead of the standard 35 font outlines, QMS gives you a total of 45. The extra fonts are from the Garamond and Helvetica Narrow families.

The printer also performed well on PC Labs' benchmark tests. In text mode, it turned out about 3.7 pages per minute, as might be expected. The PostScript graphics speeds were exceptional, thanks in part to the 16.7-MHz 68020 processor that drives the internal controller. The PS-410 comes with 2MB of memory, which can be upgraded with an additional 1MB, 2MB, or 4MB. It uses Adobe

PRINTERS LASERS

Type Manager technology to create high-quality fonts with Adobe Type 1 downloadable font outlines.

There are a few areas where the PS-410 could be improved. The gravity-feed paper tray holds only about 50 sheets of paper, which is a little skimpy for a shared printer. You will probably want the optional bottom paper cassette (\$195), which adds another 250 sheets.

The bigger problem is price. If you do not need the automatic mode sensing and multiple active ports that the PS-410 offers, other personal PostScript printers are available with lower list prices.

The QMS PS-410 could be your top choice if you need to share a printer, or if you want to switch from PostScript to PCL and back without having to punch front-panel buttons. If instead you want a dedicated PostScript printer for one computer, shop around and compare the prices of some of the other new personal laser models.

QMS PS-810 Turbo QMS PS-820 Turbo

by Alfred Poor

QMS has a long history of providing more for your money when it comes to laser printers. The QMS PS-810 Turbo and PS-820 Turbo are true to that concept, but at \$5,495 and \$6,495, respectively, they are anything but low-priced. Nevertheless, these models are an attempt to give you better value by adding features to the basic 8-ppm Canon-engine PostScript printer.

The main difference between the two printers is paper handling. The PS-810 Turbo has a single 200-sheet paper cassette, while the PS-820 Turbo offers two cassettes (though it does not give you duplex printing). Based on the Canon print engine, both printers offer the same excellent print quality along with the convenience of a single toner and drum cartridge.

Both printers have parallel ports, as well as an AppleTalk/RS-422 port. A SCSI port on the back connects not to a computer but to a hard disk for local storage—which is useful for large downloadable PostScript font libraries.

Both printers also use true Adobe PostScript Version 5.1.7b and come with the standard complement of 35 font outlines. Besides PostScript, you can also

select an HP LaserJet Plus emulation mode. The selection is a little tricky to make: Numbers on a thumbwheel on the back of the printer represent different combinations of emulation and connection port. You have to refer to a table in the manual to know which number on the dial to select.

The LaserJet emulation takes advantage of the PostScript features; for example, you can use the Times Roman and Helvetica fonts and even scale them on the fly using PCL commands. The printers do not include a true Line Printer font, however, but use a small version of Courier instead. And there is no symbol set with line-drawing characters in any of the fonts.

Both printers also had a problem with our PCL compatibility test: When confronted with nested macro calls, they misprinted the test pages in a most spectacular manner. While this is a relatively fine point and will not cause trouble in most applications, it weakens our confidence in the printers' PCL emulation. A



QMS PS-810 Turbo
QMS PS-820 Turbo
QMS Inc., One Magnum Pass, Mobile, AL 36618; (800) 631-2692, (205) 633-4300 ext. 605.
List Price: \$5,495 (810 Turbo); \$6,495 (820 Turbo); upgrade to 3MB RAM, \$495; upgrade to 4MB, \$995; upgrade to 8MB, \$2,490; 20MB hard disk, \$995; 40MB hard disk, \$1,495; optional paper cassette, \$75.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 8.5 x 18 x 26 (810 Turbo); 12.3 x 17.8 x 26.7 (820 Turbo).
Weight: 55 lbs. (both units).
Emulations: PostScript, HP LaserJet Plus, HPGL.
In Short: The QMS PS-810 Turbo and PS-820 Turbo are fast PostScript printers based on 8-ppm engines, but their speed is comparable with many other new PostScript controllers that appeared this year. As a result, the list prices for these two printers are high compared to the competition and make them less likely to be attractive values.

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QMS representative said that a fix is under development and will be included in future releases of the printers.

We did not test HPGL emulation mode, but both the PS-810 Turbo and the PS-820 Turbo also offer HPGL plotter language support, which is quite useful for printing graphics and charts from presentation graphics programs.

The main selling point for these two printers is their speed. With 8-ppm engines, they offer a longer useful life and faster print speed than the new breed of personal laser printers. The "Turbo" in their name refers to their fast controller,

FONTS & FEATURES QMS PS-820 Turbo															
PostScript								HP LaserJet Plus							
Helvetica				Times				Courier				Line Printer			
Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold	Underline	Sub Super	Italic	Bold
8.9-point															
10-point															
12-point															
14-point															
Scalable															

designed to offer better PostScript performance. Unfortunately, the speed advantage does not show clearly in our test results.

The printers managed about 7.5 ppm in text mode, an expected rate for these print engines. The PostScript graphics output was fast compared with printers from prior years, but PostScript printers as a class have become significantly faster. As a result, some of the printers were able to produce PostScript graphics as fast as or even faster than the two QMS Turbos.

These two printers would have been winners a year or two ago, but they fall short of the mark today. With list prices more than twice those of competing machines that can print graphics just as fast or faster, the QMS PS-810 Turbo and PS-820 Turbo are difficult to accept on a price/performance basis. Other PostScript printers are a better value.

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You save	\$1,125

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document exactly as you'd send it to your printer.

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2. With the SatisFAXtion board you get true WYPIWYF™—what you print is what you fax. Text is never distorted, fonts never switched, formats never lost. You can even connect a scanner and fax

**Ordinary fax boards
make you look this bad.**

**The SatisFAXtion board
makes you look this good.**

photo-quality images with up to 256 levels of grey.

3. Once a fax starts coming in or going out, most boards bring the work your computer's doing to a screeching halt. Even a simple fax could tie up your PC for several minutes. But the SatisFAXtion board has its own dedicated 16 MHz microprocessor. All your faxing happens entirely in the background, so you and your PC don't skip a beat.

4. The SatisFAXtion board automatically configures and installs itself in your PC. Cheaper boards are a nuisance, with DIP switches, jumpers, and long, convoluted procedures to mess with.

5. If you ever have a question about your

SatisFAXtion board, you can get answers directly from Intel experts—either by phone, fax, or modem.

6. Offices don't communicate by fax alone, so the SatisFAXtion board gives you a built-in

MNP 5 modem that works twice as fast as ordinary modems. This alone is worth \$300!

7. While cheaper boards hog over 100K of conventional memory just to send a fax—even if your PC has expanded RAM—the SatisFAXtion board needs as little as 9K.



een an inexpensive a cheap one:

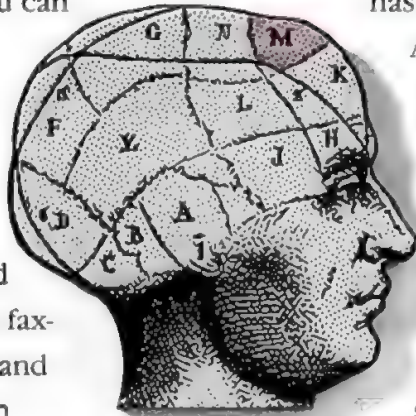
Which means you can easily fax from within even the most powerful, memory-hungry applications.

8. If you need help while you're faxing, just press F1 and follow the built-in directions.

9. Our board is covered by a 5-year warranty—more than twice as long as cheaper fax boards. (We'll leave it to you to figure out what that implies.)

10. No other fax board is designed to run crash-free under Windows 3.0. Just load *FAXit® For Windows* software—which, by the way, is free to all SatisFAXtion buyers—onto your PC, and you can fax directly from any Windows 3.0 application that can print.

11. What more could we add to the fax board that



has everything?

Actually, quite a bit: For a limited time, when you buy the SatisFAXtion board you'll also get *PC Tools Deluxe™* software free, as well as \$100

worth of discounts on other PC hardware and software products.

If you'd like to learn more—and believe us, there's plenty more to learn—just

call (800)525-3019 and ask us to fax you document #9996. Or call Intel customer service at (800)538-3373.



We think you'll find that the difference between a cheap fax board and an inexpensive one can really be summed up in one word: SatisFAXtion.



intel®

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QMS PS-2210

by Alfred Poor

The QMS PS-2210 will never be mistaken for a personal printer. At 91 pounds, this 22-ppm machine takes up a significant amount of counter space, and with a list price of \$11,995, you aren't likely to see one on every desk any time soon. But for people looking to print lots of PostScript quickly, the PS-2210 could be like the elephant in your living room: Anywhere he wants to sit is just fine.

The PS-2210 is a little tricky to set up, as its internal configuration more closely resembles an office copier than a desktop

lines, which is four more than most PostScript printers have.

It's easy to hook computers up to this printer. There are both parallel and serial ports, plus a third port that serves as either an AppleTalk connector or an RS-422 port. Besides membrane keys, the front panel has an LCD with two 20-character lines that post configuration instructions and status messages in plain English.

The printer comes with true Adobe PostScript Version 51.0e, as well as support for HP LaserJet Plus and HPGL plotter emulations. Again, we did not test the HPGL mode, but the LaserJet mode exhibited some flaws. While you can access Helvetica and Times Roman fonts from within PCL, there is no PC-8 symbol set with line-drawing characters, and the Line Printer font is simulated by using a small version of Courier. The printer also failed our PCL compatibility test because it could not handle nested macros. This problem is not likely to cause trouble for most applications, but it does call into question the overall quality of the LaserJet emulation. A QMS representative acknowledged that the com-

pany is working to correct the problem.

Aside from the deficiencies in the LaserJet mode, the printer operated flawlessly. At 1.0 gppm, the PostScript graphics speed was among the fastest of the printers we tested this year, as was the 17.3-ppm PostScript text speed. LaserJet text was even faster, at 18.3 ppm, ranking the PS-2210 among the fastest machines we've seen this year.

The one detail missing to support this high speed and high volume is an ample paper supply: The printer comes with only one 250-sheet cassette. QMS also offers a PS-2220, with two 250-sheet cassettes; this unit carries a list price of \$13,995—\$2,000 more than the otherwise identical PS-2210.

The QMS PS-2210 offers speed and endurance at a list price much lower than that of other machines with similar features. If you need to print long runs unattended, you might want to spend the extra money for the PS-2220 and its second paper cassette, but either printer makes a superior choice for heavy-duty PostScript applications.

Star LaserPrinter 8II

by Bruce Brown

The base-model Star LaserPrinter 8II uses the 8-ppm, 300-dpi Canon SX laser engine and costs \$2,649. You can expect to find street prices at about \$1,500. The printer includes HP LaserJet Series II, IBM Proprinter, Epson FX, and Diablo 630 ECS emulations. The \$999 LincPage option, a PostScript-compatible interface board, is also available. The version we tested, with the LincPage and 5MB RAM, carries a whopping \$5,847 list price.

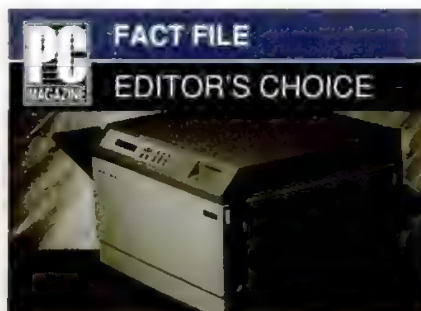
Measuring 8.5 by 18 by 26 inches, the Star printer weighs 45 pounds. Parallel and serial ports are both standard, as is 1MB RAM. The Canon SX engine, with its one-piece, easy-to-install toner/developer cartridge, has an expected life of 300,000 printed sheets and a rated monthly duty load of 3,000 sheets. The rated cost per sheet (not counting paper) is 3.3 cents for consumables only, or 4.1 cents for consumables plus hardware. Installing the Canon SX-compatible one-piece toner cartridge is simple. New cartridges list for \$145 from Star but are widely available for under \$100.

The standard Star LaserPrinter 8II

FONTS & FEATURES											
QMS PS-2210 Turbo											
PostScript											
	Helvetica			Times			Courier			Line Printer	
	Underline	Sub-Super	Italic	Underline	Sub-Super	Italic	Underline	Sub-Super	Italic	Underline	Sub-Super
8/9-point											
10-point											
12-point											
14-point											
Scalable											
HP LaserJet Plus											
	Underline	Sub-Super	Italic	Underline	Sub-Super	Italic	Underline	Sub-Super	Italic	Underline	Sub-Super
8/9-point											
10-point											
12-point											
14-point											
Scalable											

printer. The printer comes with a warranty for only 90 days, but QMS offers an optional maintenance agreement that customers who rely on these machines for large volumes of work often choose. The machine has a recommended duty cycle of 20,000 pages per month, or nearly two reams of paper every day, which explains its appeal for heavy-duty applications.

The PS-2210 is the only printer in our test lineup this year that can handle 11- by 17-inch paper, which should make it of special interest to desktop publishers who need to create large layouts. The printer comes with 4MB of memory, and it offers a SCSI port for an external hard disk in case you wish to download and store additional font outlines. You may not need extra fonts, however: the PS-2210 comes with 39 internal font out-



QMS PS-2210

QMS Inc., One Magnum Pass, Mobile, AL 36618; (800) 631-2692, (205) 633-4300 ext. 1253.

List Price: \$11,995; 20MB hard disk, \$995; 40MB hard disk, \$1,495; optional paper tray, \$115.

Standard Warranty: 90 days on parts and labor.

Dimensions (HWD): 14.2 x 43.6 x 20 in. **Weight:** 91 lbs.

Emulations: PostScript, HP LaserJet Plus, HPGL.

In Short: The QMS PS-2210 is expensive compared to smaller, 8-ppm machines, but the price is excellent for a true PostScript printer rated at 22 ppm and capable of handling 11- by 17-inch paper at 300 dpi. The 250-sheet paper cassette is small for production runs, but the rest of the machine is built for speed and heavy use.

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Everything You Ever Wanted In UNIX. And Less. \$99.95*

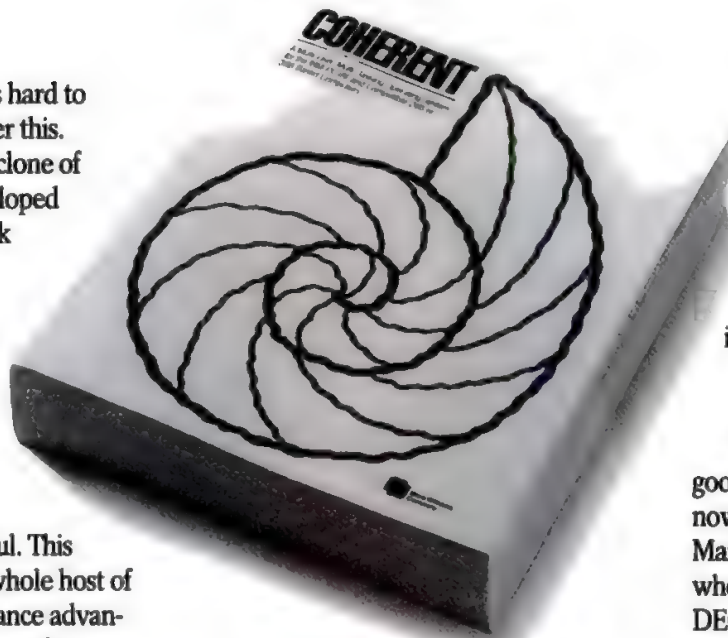
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No. of Manuals	1	8
No. of Disks	4	21
Kernel Size	64K	198K
Install Time	20-30 min.	3-4 hours
Suggested Disk Space	10 meg	30 meg
Min. Memory Required	640K	1-2 meg
Performance*	38.7 sec	100.3 sec
Price	\$99.95	\$1495.00

*Byte Excel benchmark, 1000 iterations on 20 MHz 386. Hardware requirements: 1.2 meg 5¼" or 1.4 meg 3½" floppy, and hard disk. SCSI device driver available soon. Does not run on Microchannel machines.

includes Courier, Prestige Elite, Times Roman, and Line Printer fonts. The Star machine does not accept standard Hewlett-Packard font cartridges, but Star sells seven font cartridges ranging in price

FONTS & FEATURES	
Star Micronics LaserPrinter 8II	
HP LaserJet Series II	
	Helvetica Times Courier Line Printer
	Underline Sub-Super Italic Bold Underline Sub-Super Italic Bold Underline Sub-Super Italic Bold Underline Sub-Super Italic Bold
8/9-point	
10-point	
12-point	
14-point	
Scalable	
IBM Proprinter	
	Bold Italic Sub-Super Underline
10 cpi	
12 cpi	
Compressed	
Proportional	

from \$139 to \$200. You can also use HP-compatible downloaded or soft fonts in HP mode.

The LaserPrinter 8II provides a straight-through, faceup-delivery paper path or a C-shaped, facedown, collated path. The standard letter-size paper cartridge holds 200 sheets and accommodates envelopes, with an adjustable top-mounted guide for single-envelope or heavy-paper feeding. A legal-size paper cartridge is a \$149 option.

You'll use the LaserPrinter 8II's control panel especially if you change between emulation modes often. The panel includes six membrane buttons, a 16-character LCD and three LED indicators. The documentation assists ably in helping you learn the panel menus.

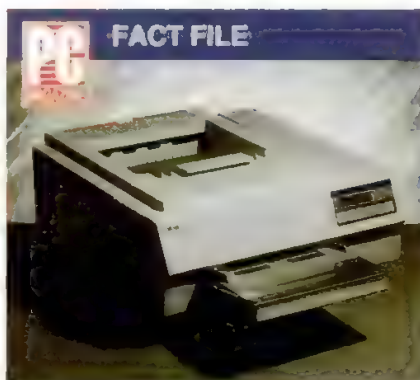
In its HP LaserJet Series II emulation, the LaserPrinter 8II performed at a rate of 2.1 gppm. In PostScript mode, it printed at 0.1 gppm. The vastly slower speed, however, resulted in output of far better quality. On our text speed test, the LaserPrinter 8II scored a respectable 7.5 ppm in both LaserJet and PostScript modes, and it fared very well on the Hewlett-Packard and IBM Proprinter compatibility tests.

The LaserPrinter 8II's PostScript compatibility, however, suffered during our tests. The unit did print our graphic in PostScript mode, and it will probably handle programs that produce PostScript-compatible graphics. Nevertheless, its

PRINTERS LASERS

compatibility fell short when it tried to emulate the Apple LaserWriter implementation of PostScript—the standard we used in our testing, which works flawlessly with true PostScript ROMs. The error showed up in page-cleanup routines, when the LaserPrinter 8II waited for job-finished signals it never received, resulting in a time-out error message on the LCD panel.

A second error occurred when we attempted to print the PostScript status page. Instead, we received an Undefined



Star LaserPrinter 8II

Star Micronics America Inc., 420 Lexington Ave., Suite 2702, New York, NY 10170; (800) 447-4700.

List Price: \$2,649; upgrade to 2MB RAM, \$400; upgrade to 3MB, \$1,199; upgrade to 5MB, \$2,199; LinePage PostScript compatible option, \$999; optional legal feeder, \$149; optional A4 feeder, \$129; optional executive or B5 feeder, \$135; optional secondary letter tray, \$129.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 8.5 x 17.8 x 25.8 in.

Weight: 45 lbs.

Emulations: HP LaserJet Series II, IBM Proprinter, Epson FX, Diablo 630.

In Short: Star Micronics LaserPrinter 8II sports 8-ppm printing and a one piece toner and developer setup, includes the most important standard emulations, and has an optional PostScript-compatible add-on board. A low street price makes this printer worth another look.

CIRCLE 845 ON READER SERVICE CARD

Font message on the control panel.

True PostScript printers print a status page on power-up, which the LaserPrinter 8II does not do. It will print a status page if you put it in test mode via the control panel.

All in all, the LaserPrinter 8II appears to be PostScript-compatible for normal printing jobs, but while the PostScript implementation may follow strict Adobe PostScript rules, it diverges a bit from the

standard Apple LaserWriter implementation of PostScript that many software packages use in their printer drivers. You'd better check for compatibility with your intended software before purchasing this printer with the PostScript-compatible card.

Are you looking for a good buy in an 8-ppm, HP LaserJet Series II-compatible printer with an easy-to-install toner cartridge? At a street price of around \$1,500 with four standard emulations, the Star LaserPrinter 8II might be the deal you want. Want PostScript compatibility as well? You may decide to look elsewhere; the LaserPrinter 8II's PostScript-compatible option works in most situations, but its hint of incompatibility should be cause for caution. Test your software on this printer before buying.

Texas Instruments microLaser

by Bruce Brown

Texas Instrument's cube-like \$1,799 microLaser won't take up much room on your desk. If you have desktop space to spare, this 33-pound, 10.5- by 13- by 14-inch (HWD) printer will deliver text performance that surpasses the 6-ppm rating of its Sharp laser engine in its standard HP LaserJet Series II emulation mode and its optional Adobe PostScript mode.

Available for a street price of about \$1,200—a bit higher than some of the other personal lasers on the market—the microLaser comes with a parallel port and 512K of RAM. (A \$49 serial port option comes with a 25-pin plug, and the \$145 serial port option includes an AppleTalk interface as well.) Its font set, which includes Line Printer 16.66-pitch, and Courier, Courier Bold, and Courier Italic (all in 10- and 12-pitch and portrait and landscape orientations), is somewhat limited. But it is richer than that of the LaserJet Series II.

The printer works with downloadable HP LaserJet Series II-compatible fonts or with optional TI font cartridges called microCartridges. TI currently sells four microCartridges at prices ranging from \$250 to \$295, and Epson FX-80 and Diablo 630 emulation cartridges at \$195 each. Two 1MB PostScript boards are also available: a \$700 board that offers 17 PostScript-compatible fonts, and a

\$1,200 board that comes with 35 fonts.

If you plan to do graphics printing you'll want to increase the printer's memory. You can boost the microLaser's RAM from 512K to a maximum of 4.5MB by adding 1MB RAM cards that cost \$495 each, a fairly high price.

The microLaser's Sharp laser engine has a rated life of 300,000 sheets and a recommended monthly duty cycle of 3,000 sheets. Replaceable supplies include a toner cartridge, a developer cartridge, and an OPC cartridge; installation of these consumables is well-covered in TI's especially helpful documentation. Toner cartridges, good for approximately 1,500 sheets each, come in a package of

PRINTERS LASERS

Other paper-feeding options include a second paper tray for \$395 and a 40-piece envelope feeder, also for \$395. Paper output can be in either faceup reverse order or facedown collated order.

The microLaser's front control panel uses a 16-character, one-line LCD screen, 12 membrane switches, and four LED indicator lights. You can use the switches

FONTS & FEATURES															
Texas Instruments microLaser															
HP LaserJet Series II															
Helvetica				Times				Courier				Line Printer			
Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold	Underline	Sub/Super	Italic	Bold
8.9-point															
10-point															
12-point															
14-point															
Scalable															

to select emulation, portrait or landscape printing, and to choose typeface, pitch, and symbol set. A complete printer parameter setup menu is available through the control panel as well. The overall menu structure is clearly organized, making the printer easy to use.

Under HP LaserJet emulation, the microLaser printed at a rate of 6.5 ppm in the PC Labs text speed test and 2.1 gppm in the graphics speed test. The printer passed the LaserJet Series II emulation test, with one exception: a single, vertical-line character printed outside the HP's normal margins. The wider page definition was caused by our evaluation machine's installed PostScript board, since PostScript printers can use wider margins than the LaserJet.

When we tested the microLaser with the 35-font PostScript board installed, it printed the PostScript status page just right—a good test of compatibility. With the PostScript emulation active, the microLaser yielded a graphics speed of 0.6 gppm and a text speed of 6.3 ppm. As expected, the PostScript graphics test output is noticeably clearer than the HP-mode output.

The TI microLaser has a lot to offer: It's compact, prints faster than its speed rating, and is easy to use. While it's not the cheapest low-end laser in the world, if you don't mind using separate consumables, the microLaser offers a good deal for the dollar.

Toshiba PageLaser6

by Bruce Brown

The Toshiba PageLaser6 was first introduced last fall at \$1,899, and we reviewed it in our issue of June 12, 1990. Now its list price has dropped to \$1,549, its street price is hovering right around the \$1,000 mark, and it includes both HP LaserJet Series II and IBM Proprinter XL emulation modes. The PageLaser6 is one of several laser printer models currently on the market that are built around the widely used TEC-designed 6-ppm laser engine.



Texas Instruments microLaser

Texas Instruments Inc., PO Box 202230, Austin, TX 78720-2230; (800) 527-3500. **List Price:** \$1,799; upgrade to 1.5MB RAM, \$495; upgrade to 2.5MB, \$990; upgrade to 3.5MB, \$1,485; upgrade to 4.5MB, \$1,980; PostScript option (including 1MB RAM and 17 fonts), \$700; PostScript option (including 1MB RAM and 35 fonts), \$1,200; emulation cartridges, \$195 each; font cards, \$195 to \$295; optional second paper cassette, \$395; optional envelope feeder, \$395; optional letter, legal, A4, B5, executive, or invoice tray, \$79 each.

Standard Warranty: One year depot or 90 days on-site.

Dimensions (HWD): 10.5 x 13 x 14 in.

Weight: 33 lbs.

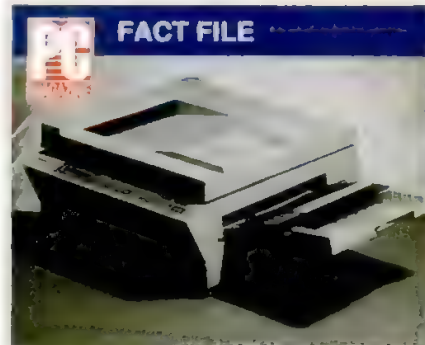
Emulations: HP LaserJet Series II.

In Short: A little more expensive than some of the other low-end lasers, the microLaser uses the 6-ppm Sharp laser engine, which printed above spec at 6.5 ppm on PC Labs text speed test. A small footprint and an optional PostScript board make this nifty number worth considering.

CIRCLE 546 ON READER SERVICE CARD

two for \$69. The developer cartridge, which should be replaced every 24,000 sheets, costs \$149. The OPC cartridge lists for \$189 and is good for 50,000 sheets.

The printer's standard paper cassette holds 250 letter-sized sheets, and there is a legal-size paper tray available for \$79.



Toshiba PageLaser6

Toshiba America Information Systems Inc., Printer Products Division, 9740 Irvine Blvd., Irvine, CA 92713; (800) 999-4273.

List Price: \$1,549; upgrade to 1.5MB RAM, \$449; upgrade to 2.5MB, \$999; upgrade to 4.5MB, \$1,999; PostScript option including 2MB upgrade, \$2,199; font cartridges, \$249 each.

Standard Warranty: One year from date of purchase, dealer or depot service.

Dimensions (HWD): 8.3 x 24.8 x 16 in.

Weight: 35 lbs.

Emulations: HP LaserJet Series II, IBM Proprinter.

In Short: A very well priced 6-ppm laser printer, the PageLaser6's HP LaserJet Series II emulation is right on the money as is its IBM Proprinter emulation. With a 5.6-ppm tested speed in text mode and flexible paper handling, this printer is a good deal, especially if you can find one priced under \$1,000.

CIRCLE 547 ON READER SERVICE CARD

The PageLaser6 weighs 35 pounds and measures 8.3 by 24.8 by 16 inches. The unit includes both parallel and serial interface ports for maximum versatility. The PageLaser6's resident fonts include Courier 12-point, Courier Bold 12-point, Prestige Elite 10-point, and Line Printer 10-point. HP PCL 4-compatible downloadable fonts will work with the PageLaser6, and Toshiba will also sell you a Professional Collection of 65 fonts for \$295.

PRINTERS LASERS

The TEC engine's 300,000-sheet rating yields a 3.4-cent cost per page for consumables and hardware. Replaceable supplies include 1,500-page toner cartridges, which cost \$49 for a package of two, and a photoconductor kit, which retails for \$149 and must be replaced by the user every 10,000 sheets. The monthly duty cycle is 4,000 sheets, according to Toshiba.

On our PC Labs Graphics Speed Test,

the PageLaser6's scores were 1.1 gppm in LaserJet emulation mode and 1.2 gppm in Proprinter XL mode. The graphics printouts were very faithful to the originals, including the skipped lines you'll find if you run our tests (and many other graphics files) on a 24-pin Proprinter XL. The PageLaser6's text speeds were 5.6 ppm in LaserJet emulation mode and 5.1

ppm in Proprinter mode, similar to other printers using the same engine. The Toshiba passed our HP-compatibility torture test without any problem whatsoever.

The PageLaser6's standard on-board memory is 512K. You can increase the printer's memory to 4.5MB, using memory upgrades priced at \$449 for 1MB and \$1,999 for 4MB. We found this to be a bit on the expensive side, and if you require 4.5MB of RAM you probably ought to be in the market for a higher-end page printer anyway.

The standard 150-sheet tray holds letter- or legal-size paper and can also feed up to ten number 10 envelopes without difficulty. You can have the paper travel in a straight path and come out the



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MasterLink™ utility diskette for PCs comes with every unit and unleashes the power of the switch with its memory-resident access to the commands and menus.

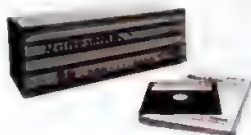
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it. We also have automatic switches, code-activated switches, buffers, converters, cables, protocol converters, multiplexers, line drivers, and other products.

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Fonts & Features

Toshiba PageLaser6

HP LaserJet Series II

	Helvetica	Times	Courier	Line Printer
	Underline	Underline	Underline	Underline
	Sub-Super	Sub-Super	Sub-Super	Sub-Super
	Italic	Italic	Italic	Italic
	Bold	Bold	Bold	Bold
8.9-point				
10-point				
12-point				
14-point				
Scalable				

IBM Proprinter

	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

back faceup, or travel in a C-shaped path and fall facedown in collated order in the printer's top bin. We experienced no difficulty with either method of feeding paper.

You use the PageLaser6's easy control panel—with its 16-character LCD menu and status display screen, LED indicators, and membrane buttons—to set the printer configuration, choose emulations, and cycle through resident fonts.

The Toshiba PageLaser6 is one more no-frills, low-cost laser in the crowd of 6-ppm TEC engine printers. But the price is right, and the LaserJet Series II and Proprinter XL emulations are your best choice for a countless variety of personal or small-office text-printing chores. If you're looking for a good deal, and a good, solid printer, check out the PageLaser6.

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FormBase is easy to learn and use. You just point and click to draw the form. Fill it out. Tell it what calculations to perform. And get information to and from other databases, spreadsheets, or word processing programs. You use the familiar environment of Microsoft Windows. All without having to use any programming languages. Anyone who sees FormBase work becomes a fan quickly. For example:

"...FormBase is flexible, sophisticated, and—in words not traditionally applied to relational databases—fun to use."
PCResource, May 1990

"FormBase is the kind of product users have always wanted their software to be...[its] intuitive graphic interface makes complex, feature laden tasks easy to learn and use."

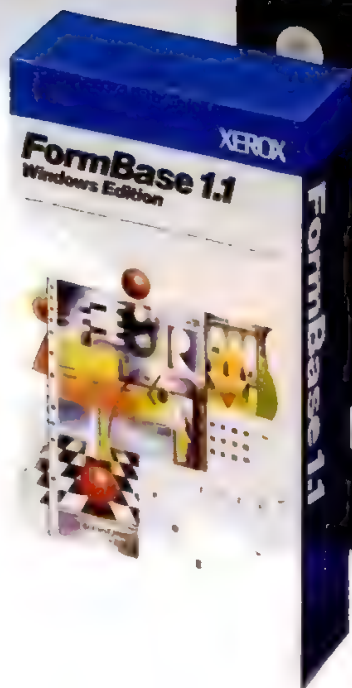
PC PUBLISHING, April 1990

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For a complimentary FormBase demo disk, call our toll free number. And see why FormBase is the intelligent form of data management. (800) 822-8221 in USA; (800) 228-8579 in Canada. For training information, call (800) 445-5554. Ventura Software Inc., a Xerox company.

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**The intelligent form of
data management.**

CIRCLE 247 ON READER SERVICE CARD



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Can you stomach spending an extra \$10,000 for a PC network or UNIX® workgroup server with dubious service?

We can't. Workgroups are too critical to leave in the hands of amateurs.

So Dell has gone overboard in servicing servers. In fact, we just won a PC Week Poll for Corporate Satisfaction for servers, where our reliability and service were rated far above our competitors.

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Would you spend an extra \$10,000 for iffy service?

We think it's a no-brainer.

We have two new 486™ EISA servers. Dell

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gives you a choice of the 25 MHz Dell™ 425TE and the 33 MHz Dell 433TE.

The 25 MHz Dell System® 425TE has up to 64 MB of RAM capacity, 11 storage bays, and a whisper-quiet 300 watt power supply. We've also built in features such as password protection, a software controlled reset switch, and an efficient cooling system to protect component life.

What's more, both the 433TE and the 425TE have the Dell designed SmartVu™ diagnostic display built in. This ingenious innovation helps identify problems even if the monitor goes down.

For even more performance, the 33 MHz Dell System 433TE is everything our 425TE is, with 32% more speed. The Dell exclusive memory design with a 128 KB external cache gives it maximum throughput.

UNBELIEVABLE PRICES.



\$11,799
Dell System 433TE
Lease: \$423/mo.**

\$9,599
Dell System 425TE
Lease: \$359/mo.**

THE NEW DELL SYSTEM 433TE 33 MHz EISA i486™ AND THE NEW DELL SYSTEM 425TE 25 MHz EISA i486.

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- 128 KB external cache (433TE).
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- Eight 32-bit EISA expansion slots (six EISA master slots and two EISA slave slots).
- High-performance IDE (80 MB, 100 MB, 190 MB) and ESDI (130 MB, 650 MB) hard disk drives.

650 MB VGA Color Plus System	433TE	425TE
Using 2 MB SIMMs	\$11,799	\$9,599
Using 4 MB SIMMs	\$12,199	\$9,999
Prices listed include 8 MB of RAM		

AD CODE 11B78



UNBELIEVABLE.

course, they're completely compatible with all major network operating systems, including Novell, 3COM and Banyan.

In a UNIX environment, the 425TE and 433TE are perfect for workgroups supporting either traditional multiuser or

high-speed client/server environments.

You can buy Dell servers preloaded with UNIX System V, making them literally plug and play. Even more impressive is the fact that UNIX system administration can be done by Dell, remotely.

Servicing servers is beyond most Compaq dealers. If a server happens to go down, your whole company can go down with it.

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We wouldn't.

That's why we have a special advanced systems hotline so you can call us direct. Dell is an AT&T UNIX source code licensee and an authorized Novell Network Reseller.

On those rare occasions we can't fix it over the phone, Xerox technicians will come to your office with the solution or part in hand.^Δ

"Server problems? Just ship 'em back, okay?"

"I know those babies like a cat knows her kittens."

"Where's the power switch?"

"My UNIX guy actually talked to the factory once."

"But he's on vacation for two weeks. Sorry."

\$24,698

Compaq SystemPro 486/333

■ **From this foundation, create a powerful PC network or UNIX workgroup.** Dell's new systems have more than enough performance to function as a LAN Server and WAN or internetworking gateway. So they're capable of supporting the most demanding server use—a multi-function network. Of

The Dell System 433TE and 425TE are Class A devices sold for use in commercial environments only. Performance enhancements, within the first megabyte of memory 384 KB is reserved for use by the system to enhance performance. All systems are photographed with optional extras. All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typography or photography. *Payment based on 36-month, open-end lease. Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices may vary. DELL SYSTEM is a registered trademark, Dell and SmartVu are trademarks of Dell Computer Corporation. Dell UNIX System V 3.2 is based on INTERACTIVE Systems Corporation 386/i386. Intel is a registered trademark of AT&T in the United States and other countries. Other trademarks and trade names are used to identify the utilities, the marks and names of their products. Dell Computer Corporation disclaims any proprietary interest in trademarks and trade names other than its own. On-site service may not be available in certain remote locations. Shipping, handling and applicable sales tax not included in the price. For information on and a copy of Dell's 30-day Total Satisfaction Guarantee, limited warranty, and Xerox's Service Contract, please write to Dell Computer Corporation, 9505 Arbutus Boulevard, Austin, Texas 78739-7299, ATTN: Warranty. ©1990 Dell Computer Corporation. All rights reserved.

There's a lot more to know before you buy a server.

When you call Dell, our experts will give you the help you need to buy an advanced PC or UNIX server.

Then we'll send it off with a 30-day no questions asked money back guarantee, and a one year limited warranty.

Call us.

We'd like to make believers out of you.

Above and beyond the call.



THE LAP OF LUXURY.

Talk about good things falling into your lap.

Dell's first laptop—the 16 MHz 386™ SX—was *PC Magazine's* Editor's Choice, and won *PC Week's* Corporate Satisfaction Poll for 386SX laptop computers.

Now we've made a faster 20 MHz model, with a new higher contrast display.

And it's only \$3,899.

Which is a hefty \$2,900 less than

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Compaq's SLT
386s/20.*

In fact, it even costs less than most slower 16 MHz laptops. How those other guys can charge so much is insane.

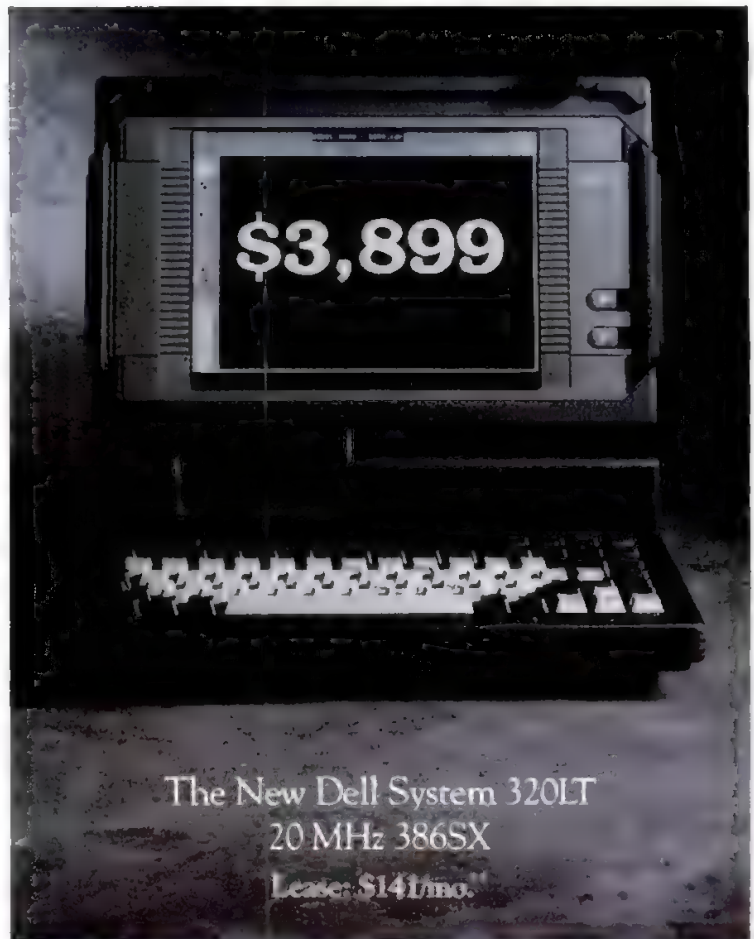
(Here's another good one: We're also cutting the price of our original 16 MHz laptop to \$2,999. That should drive our competitors up the padded wall.)

It's a desktop PC trapped in the body of a laptop.

This lightweight laptop acts suspiciously like a desktop system.

With the Intel® 20 MHz 386SX microprocessor, it's as powerful as most desktops.

It's nearly as expandable, too. You get up to 8 MB



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- 83-key keyboard with embedded numeric keypad.
- 1 parallel, 1 serial, and external VGA monitor port.
- Connector for 101-key keyboard or numeric keypad.
- Connector for external 5.25" 1.2 MB diskette drive.
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316LT: 20 MB, 1 MB RAM \$2,999
320LT: 40 MB, 2 MB RAM \$3,899

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THE LAP OF LUNACY.



of RAM, a 3.5" 1.44 MB diskette drive and a 20 or 40 MB hard drive. It also has a dedicated slot for a Dell™ Data/Fax modem, and a separate slot for a standard half-length expansion card. (On a Compaq, that expansion slot would cost you an extra \$1,000).

When it's time to stay put, you can connect our laptop to an external VGA monitor and keyboard, a 5.25" external floppy disk drive, and even to your network or mainframe.

If you can work 24 hours a day, our laptop can work 24 hours a day. Dell's special Continuous Power Battery System lets you change batteries without losing your data, or your train of thought. The system includes two lightweight rechargeable battery packs.

The service goes where you go. If you have a question, our toll-free technical hotline solves 90% of all problems over the phone. If we can't solve it over the phone, a trained technician from Xerox will be sent to your lapside the next business day—nearly anywhere in the contiguous U.S.△

For sale, for lease, for less. When you call us, you talk with a computer expert whose sole mission is to give you exactly what you

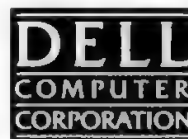
want. At a great price. We'll custom configure your laptop, give you a 30-day no questions asked money back guarantee, and a choice of leasing plans.◇

Then we'll do a configured system test, and ship it wherever you want.

Call now for either our 16 MHz or new 20 MHz 386SX laptops.

It'd be lunacy not to.

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"Overkill!"

That's the kind word *PC Week* used to describe our service.

It came up when Dell™ computers won their first

PC Week Corporate Satisfaction Poll for PCs, and our service beat the daylight out of everybody else's.

Now that we've won eight out of eight *PC Week* polls, it's even more appropriate. Because each time,

our service is called vastly superior.

While the service provided by

WHAT SERVICE!

most of our competition is often called "non-existent."

Actually, one of the nice things about our service is that you'll rarely need it.

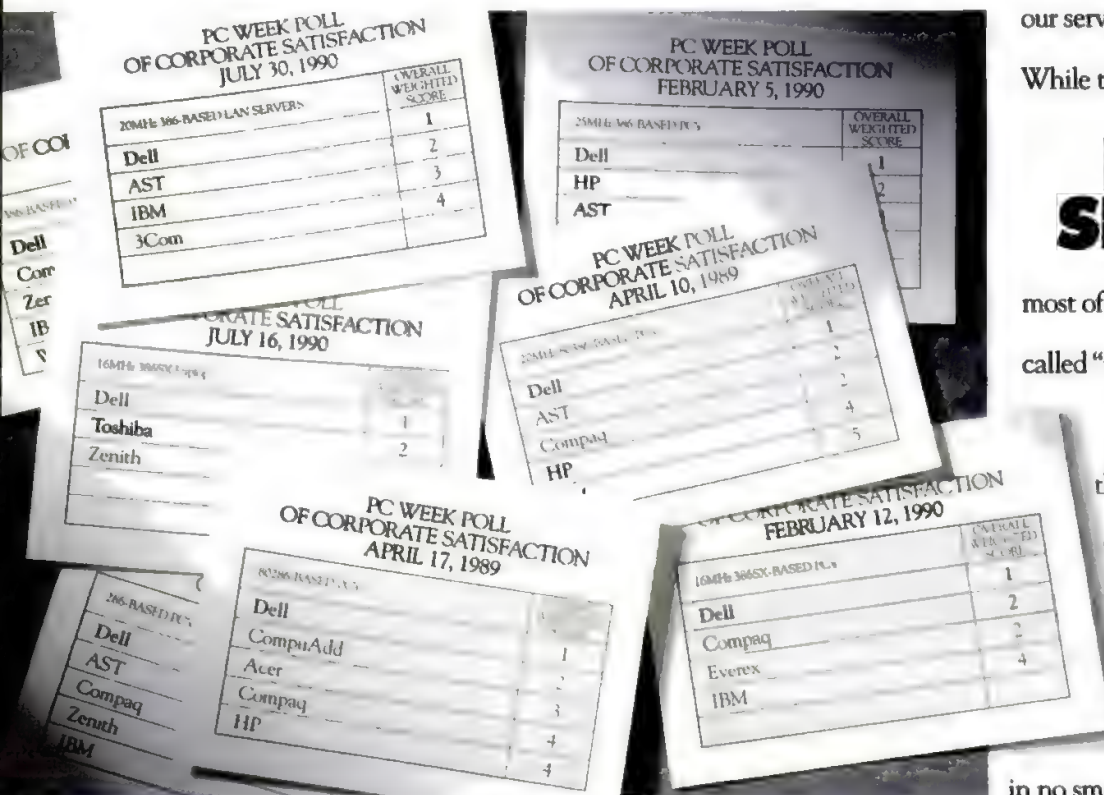
Another poll category we dominate is the one called "reliability"—due

in no small measure to our testing on

each machine as it goes out the door.

You shouldn't have to go through some Compaq dealer. It's better for you to talk directly to the manufacturer. So we've made it easy to call us direct. We have a staff of technical people trained at Dell who solve over 90% of the problems over the phone, generally in under 5 minutes.

And we're open when you're open. Our normal hotline hours are from 6am to 9pm Central Time, Monday through Friday. On Saturdays, from 8am to 4pm Central Time.



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First year of on-site service is included in the price of the computer.

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But let's say your normal hours are ridiculously abnormal.

Even if you're pulling an all-nighter, you can still call the Dell technical library on our new twenty-four hour automated TechFax line. Detailed information will be faxed

WHAT SERVICE?

back to you automatically.

But our help doesn't end there.

We've introduced a Dell Bulletin Board. When you tap into it with a modem, you'll see other questions about Dell computers. Better yet, you'll see Dell's answers, which could help you learn more about your own Dell system.

One more word about your calls:

We log every call you make to us into a database.

Over the course of years, we end up knowing your computer better than you do. This familiarity with

your computer means better help quicker.

We're actually there when you need us the most.

It doesn't happen too often, but occasionally even our technical hotline people can't solve your problem over the phone. Then the trained technicians at Xerox

will actually come to your desk the next business day, with the solution or part in hand.[△]

You can test our service right now. We figure the best way to sell you on our service is to show it in



action. Call and talk to our technicians. If you don't have a problem, make one up. Or just chat. Get a feel about what we know, and how we handle questions, and what we can do for you.

Okay, we're going to repeat this one more time:

For PC service that's been voted the best in the business eight times, call 800-TRY-DELL (800-879-3355).

It'll give you a taste of what you've been missing.



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Here's why it's worth adding another credit card to your wallet:

The Dell Direct Advantage MasterCard is just like other premium cards, and can be used at eight

of financing and leasing^o plans custom made for all sizes and sorts of businesses.**

For instance, you can lease Dell computers for as little as \$59 a month, and reap all the benefits

leasing affords.

Or you can take advantage of the Power Payment Plan.[™] On

this plan, you can lease your Dell computers, and at the end of the term, buy them outright for one dollar.

There are numerous financing plans, and we'll work with you on a plan that's in your best interest.

Get the credit you deserve.

million locations worldwide.

But, unlike other credit cards, everytime you use it you earn points toward Dell[™] products.

Plus, upon approval, you can get up to \$15,000 credit. Which is a lot more than most credit cards.

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You can get more credit than you think. Not all credit on Dell products is plastic. There are a variety

of financing and leasing plans in the industry. For information on these plans, and the Dell Direct Advantage MasterCard, call 800-688-3355.

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CIRCLE 532 ON READER SERVICE CARD

Ink jets may not be as common as impact or laser printers, but they're certainly still around. Here, PC Labs tests six new or improved ink jets that each fill specific and necessary niches in the printer market.



BY ALFRED POOR

Aside from the odd Mont Blanc fountain pen here and there, you might think liquid ink has gone the way of the quill pen. Far from being an anachronism, liquid ink is at the heart of computing's most unusual and varied class of printers: the ink jets.

All of these printers have one fact in common: They make their marks on paper by spraying tiny droplets of ink out of a printhead. While impact dot matrix printers chatter away with anywhere from 9 to 24 tiny pins, most ink jets have printheads with between 30 and 60 nozzles or more. This enables ink jets to produce high-reso-



INK JET

lution images with a single pass. Many of the printers in this year's collection can print at 300-dpi resolution, just like a laser printer. And, like a laser printer, the paper-handling mechanisms account for more of the printer's noise level than the printing process itself.

Ink jets used to share two more features, both based on their use of liquid ink. Most older ink formulations remained somewhat water soluble even after they dried—a damp finger or stray raindrop could cause a smear. Many an envelope and report were ruined as a result.

Also, because the ink could dry out and clog the tiny nozzles, loading and cleaning the printhead was often elaborate. Inevitably you would end up wearing some of the ink on yourself or your clothing.

Ink jet printers of the current generation have addressed these problems, and most have solved them well. Ink now comes in sealed cartridges that include the jet nozzles as part of the package. Every time you replace the ink cartridge, you replace the working part of the printhead, so it is less likely to wear out or clog. And the ink formulations in use today are far less prone to the ravages of a stray damp swipe.

While these printers share methods of overcoming the perils of ink, they tend to defy association with one another in other respects. Ink jet technology has survived the onslaught of low-cost lasers and increasingly sophisticated impact dot matrix machines largely because of their ability to be tailored to fill specific roles.

The Canon BJ-10e is a monochrome printer, but its notebook size and high-quality output make it the ideal adjunct for laptop computers. It would be difficult to replicate the same feature set with an impact dot matrix design.

Or consider the two color ink jets reviewed here, Digital Equipment Corp.'s Companion Color Printer and Hewlett-Packard's PaintJet XL. Color page printers that rely on thermal wax-transfer technology typically cost about five times as much as an ink jet printer and cost significantly more per page to use. Ink jets provide quick high-resolution color output and use either separate cartridges for the different color inks or one black cartridge and one filled with different colors. The quality is far better than that of impact dot matrix

printers that use multicolor ribbons, and the process is also quieter and faster.

Along with the Epson EPI-4000, the HP PaintJet XL also distinguishes itself by printing on 11- by 17-inch paper. You'd spend nearly ten times the price of either of these printers for a laser printer that could handle a page this size. Some dot matrix printers can handle this width, but they can't match the output quality or quiet operation of the ink jet printers.

There are even ink jets designed to do little more than print high-resolution text and graphics on standard cut-sheet paper. Sounds like a personal laser printer, right? These small wonders can achieve the same 300-dpi resolution with nearly the same quality at about twice the print speed, all at a price that is only half that of many personal laser printers.

Of course, not all ink jets rely on cut-sheets. Need to print on tractor-feed paper? You can't do that on a LaserJet III, but there are printers here that can do the trick.

All this diversity leads to a problem: How does one fairly test and compare these machines? The answer, of course, is that one tests them as they are meant to be used and compare them only when appro-

Advanced Printer Sharing at Half the Cost.

With SmartPrint, it's as though each computer has its own printer. SmartPrint allows several computers to share any printer automatically. It operates transparently, so you work exactly as before.

While other printer sharing devices use expensive yet limited RAM buffers, SmartPrint lets you work smarter by using advanced spooler software that buffers work to your hard disk, eliminating the chance of lost data or system hang-ups.

And, our advanced circuitry allows extra long cable lengths from each computer (up to 50 ft. parallel, 1,000 ft. serial).

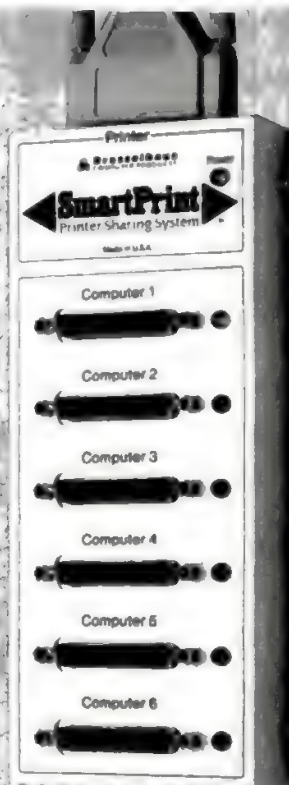
SmartPrint is a snap to install, too. Just connect your computers and printer to SmartPrint using standard cables and you're ready

to go. That's all there is to it. And SmartPrint is Hewlett-Packard and FCC approved.

Smart technology. Smart Price. It's called SmartPrint.

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PSS-P2	2	Parallel	\$129.00
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PSS-P6	6	Parallel	\$229.00
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Don't make a move with a laptop computer unless you have a Kodak Diconix printer too. See a demonstration by December 31, and get a free Kodak Weekend 35 camera!

There are all kinds of reasons to travel with a Kodak Diconix printer and your laptop. Including sudden revisions, quick letters, instant overheads. And now there's a great reason to see a Diconix printer by Dec. 31: Watch a demonstration at a participating dealer, and you'll get a certificate good for a free Kodak Weekend 35 camera! See either the Diconix 150 plus printer for DOS computers—PC Magazine's Editors' Choice—or the M150 plus printer, with Adobe Type Manager™ software, for all Macintosh computers. They're easy to carry—they're two of the smallest, lightest printers in the world—produce quality output on plain paper, and work as well on the desktop as on the road. But the free camera offer ends December 31, 1990, so saddle up today! For the name of your nearest participating dealer in the U.S. or Canada, call 1 800 344-0006.

CIRCLE 363 ON READER SERVICE CARD

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camera with
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* Suggested U.S. list price. For Macintosh interface, add \$125. © 1990 Hewlett-Packard Company PE12033

show your true colors.



No longer does your world have to be black and white.

With millions of different color shades produced by high-quality inkjet technology, the HP PaintJet printer family makes it easy for you to look brilliant.

Better yet, it doesn't take much green to get this kind of color. Only \$1,395* for the PaintJet. Or for even faster printing, larger formats, and more font capabilities, only \$2,495* for the PaintJet XL.

Of course, HP PaintJets are DOS and Macintosh compatible. Work with all your favorite graphics software. And print on transparencies as well as paper.



So call **1-800-752-0900, Ext. 1632** for your nearest authorized HP dealer. And get a firsthand demonstration of what the PaintJet family can do for your business communications.

You'll be surprised how high you can fly with color.

CIRCLE 738 ON READER SERVICE CARD



**HEWLETT
PACKARD**

PRINTERS

INK JET

prate. We've compiled test results and output samples and put them side by side in one location, but comparisons drawn from the table take on real meaning only when bolstered by the information you'll find in each review.

Regrettably, you won't find mention of one recent color ink jet printer, the Tektronics ColorQuick Model 4675, in the following pages. Our evaluation unit pro-

duced attractive output but didn't support any major printer emulations. Tektronics was unable to provide a production version of its custom printer drivers in time for us to include the printer in this issue.

It's true that you can't print multipart forms on an ink jet printer; that takes an impact printer. And you'll have to look

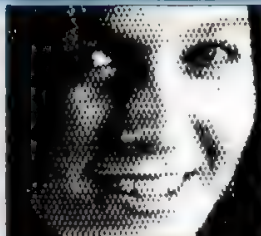
among the ranks of the lasers if you want PostScript support. But perhaps you have an application that calls for something a little out of the ordinary, either for budgetary or technical reasons. If you haven't found the perfect printer among the zappers, blinkers, hitters, and winkers, then check out the sprinklers that follow. Each ink jet has its own special mission, and one may offer just the fit you seek.

PC Canon BJ-10e

\$499

Monochrome, optionally-battery-powered ink jet printer with IBM Proprinter 24-pin emulation; optional sheet feeder, \$90

TEXT SPEED: 40 cps
GRAPHICS SPEED: 0.6 gppm
GRAPHICS TIME: 1 min. 18 sec.



Man's mind cannot grasp
of events in their complexity
but the desire to find the truth
is implanted in man's soul
10CPI Bold Underlined
NLQ 10CPI Bold Underlined



DEC LJ252 Companion Color Printer

\$1,780

Color ink jet printer with HP LaserJet Plus and HP PaintJet emulations

TEXT SPEED: 62 cps
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME: 0 min. 55 sec.



Man's mind cannot grasp
of events in their complexity
but the desire to find the truth
is implanted in man's soul
Courier Bold Underlined



Epson EPI-4000

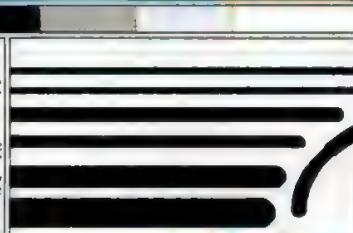
\$1,990

Monochrome ink jet printer with HP LaserJet Series II emulation; accepts 11- by 17-inch stock

TEXT SPEED: 40 cps
GRAPHICS SPEED: 1.0 gppm
GRAPHICS TIME: 1 min. 3 sec.



Man's mind cannot grasp
of events in their complexity
but the desire to find the truth
is implanted in man's soul
Courier Bold Underlined
Courier Bold Bold

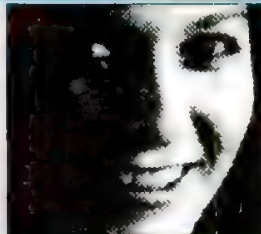


HP DeskJet 500

\$729

Monochrome ink jet printer with HP LaserJet Plus emulation

TEXT SPEED: 62 cps
GRAPHICS SPEED: 1.6 gppm
GRAPHICS TIME: 0 min. 37 sec.



Man's mind cannot grasp
of events in their complexity
but the desire to find the truth
is implanted in man's soul
Courier Bold Underlined
Letter Gothic Bold Underlined

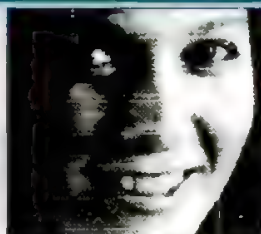


HP PaintJet XL

\$2,499

Color ink jet printer with HP LaserJet Plus emulation; accepts 11- by 17-inch stock

TEXT SPEED: 65 cps
GRAPHICS SPEED: 1.8 gppm
GRAPHICS TIME: 0 min. 34 sec.



Man's mind cannot grasp
of events in their complexity
but the desire to find the truth
is implanted in man's soul
Courier Bold Underlined
Letter Gothic Bold Underlined



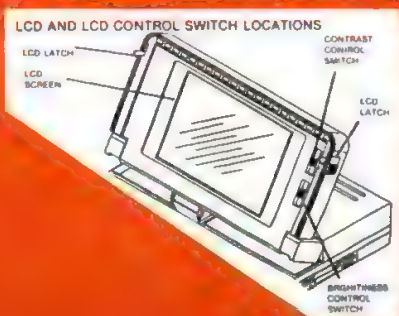
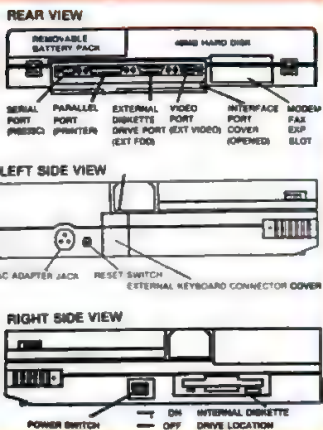
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CIRCLE 273 ON READER SERVICE CARD

Canon BJ-10e

by Bill O'Brien

Canon USA won't make a loud impact on the portable printer market this year. It has decided instead to conquer the world with a hush by releasing its 4-pound BJ-10e. The plain-paper, ink jet printer is neatly tucked into a notebook-size enclosure that measures 2.2 by 12.3 by 8.5 inches (HWD). The BJ-10e's \$499 price is not nearly earth-shattering, but this printer squeezes plenty of features into a truly portable package.

Even with the cover up to expose the friction paper-feed mechanism, the BJ-10e stands only 9.2 inches high. Still, Canon has managed to pack IBM Proprinter 24-pin and Canon BJ-130e emulations into the printer. The actual printing chores are done by a 1.8- by 2.5-inch ink cartridge with a 700,000-character life expectancy and a miser-pleasing \$25 replacement cost.

In its standard configuration, paper handling is not the BJ-10e's forte. The friction-feed mechanism will accept 18- to 24-pound paper and the machine will take almost anything you can throw at it without a hitch, provided you don't mind feeding in the paper one sheet at a time. Long cut-sheet printing jobs are not an attractive proposition.

FONTS & FEATURES				
Canon BJ-10e				
IBM Proprinter 24-pin				
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

To make matters worse, it quickly became evident during the course of testing that the BJ-10e did not like to have paper fed to it before it had completely ejected the preceding sheet. It jammed every time we tried. Canon recognizes this limitation and offers an optional 30-sheet cut-sheet feeder for \$90. This option will be a mandatory purchase if your software does not support manual paper feeding. Running with the optional auto feeder for the PC Labs two-page speed test, the BJ-10e ran at 40 cps in default mode. In economy mode, the BJ-10e ran at 39 cps, substantiating Canon's claims.

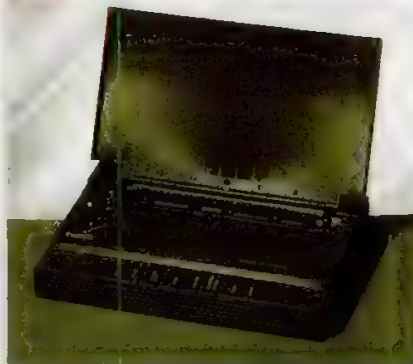
Canon rates its ink jet at 83 characters per second when running at 10 cpi and 100

PRINTERS

INK JET

FACT FILE

EDITOR'S CHOICE



Canon BJ-10e

Canon USA, One Canon Plaza, Lake Success, NY 11042; (800) 848-4123, (516) 488-6700.
List Price: \$499; single-bin cut-sheet feeder, \$90; optional battery pack, \$50; carrying case, \$29.95; additional AC adapter, \$35; replacement ink cartridges, \$25.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 2.2 x 12.3 x 8.5 in.

Weight: 4 lbs.

Emulations: IBM Proprinter, Canon BJ-130e.

In Short: The Canon BJ-10e produces near-laser-quality text and is small enough to slide into your briefcase alongside a notebook-size laptop. The optional cut-sheet feeder is highly recommended for any prolonged use.

CIRCLE 669 ON READER SERVICE CARD

cps at 12 cpi. The company reports that this rate is consistent whether using the printer's Courier, Prestige, or Elite typefaces and regardless of any applied character enhancements. Attaching the optional sheet feeder requires standing the printer vertically on its back, turning the foot on its base 90 degrees to keep it from turning over, and clipping the sheet fed to the bottom of the printer.

One thing is certain: This BJ-10e's character composition is solid. There are no jagged serifs, and it would be hard to distinguish this printer's copy from that of a laser printer. The reason, of course, is the 64-nozzle head on the ink cartridge. Canon uses it to create a 36- by 48-character matrix for high-quality printing. Even the 18- by 48 economy-mode matrix rates above normal dot matrix output.

Graphics was another question entirely. Though printing at a relatively quick 0.8 gppm, the image produced was slightly streaked and overlapped, and the patterns used to represent the gray scale and color segments of the graphics sample were simply unattractive. Likewise, despite the

printer's rated maximum resolution of 360- by 360-dpi, the solid-line sections of our graphics sample were jagged. This was a strict dot matrix treatment of the image in the true spirit of the Proprinter.

Power is normally supplied via an included AC adapter, but the printer becomes truly portable with the addition of Canon's optional \$50 battery pack. Canon claims a 30-sheet, or 45,000-character, battery life with recharging done on the fly via the AC adapter. With the 0.6-pound battery and the AC adapter, the weight of the BJ-10e rises to about 6 pounds, but this is still within the weight range of most notebook computers. The printer comes standard with a 37K buffer.

The Canon BJ-10e won't work wonders with graphics, but its text output is top quality, and nearly indistinguishable from that of a laser. If you need this kind of output from a notebook-size printer, the BJ-10e is the way to go.

DEC LJ250 Companion Color Printer DEC LJ252 Companion Color Printer

by Bruce Brown

If you like the idea of the Hewlett-Packard PaintJet but need a printer that can get along with DEC equipment, take a look at Digital Equipment Corp.'s ink jet offering, a repackaged version of the PaintJet (see "King Color: New Printers Banish Black and White," May 31, 1988). Available in a parallel version, the LJ252, and a serial version, the LJ250, this printer lists at \$1,780 and comes with one black and

FONTS & FEATURES				
DEC LJ252 Companion Printer				
HP LaserJet Plus				
Helvetica	Times	Courier	Line Printer	
Underline	Underline	Underline	Underline	
Sub/Super	Sub/Super	Sub/Super	Sub/Super	
Italic	Italic	Italic	Italic	
Bold	Bold	Bold	Bold	
8/9-point				
10-point				
12-point				
14-point				
Scalable				



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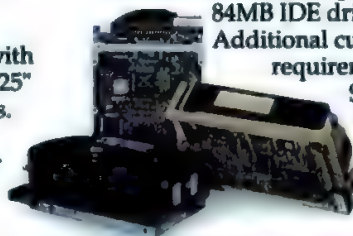
The color VGA option includes Swan's super-fast video card with 512K on board plus our 1024 monitor to deliver crisp 1024 x 768 images. Many other video options are available—call for details.

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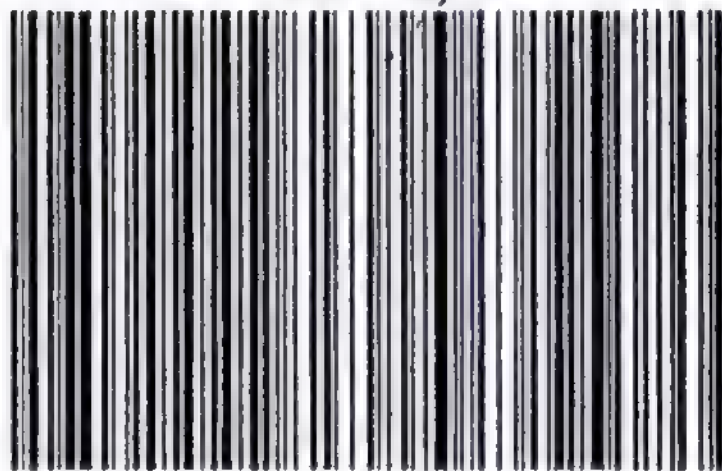
Many other configurations available.



1. Follow instructions on the other side

Back

Gbs5lipBack-0018



Inverted Back

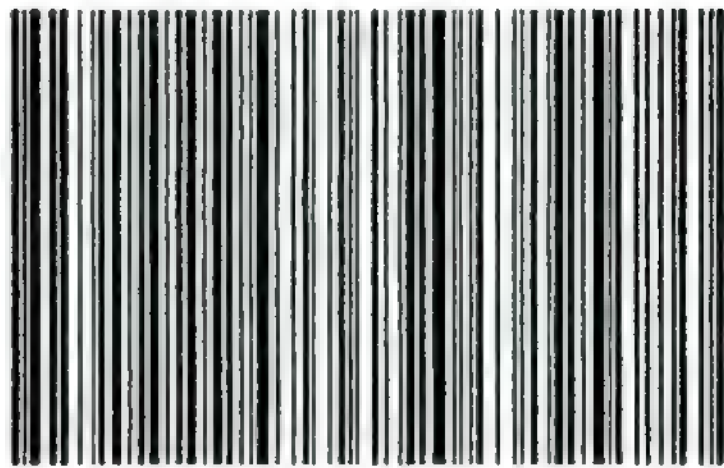
1. Follow instructions on the other side

Folded edge of the page

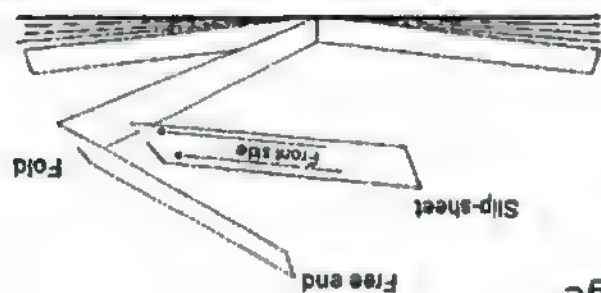
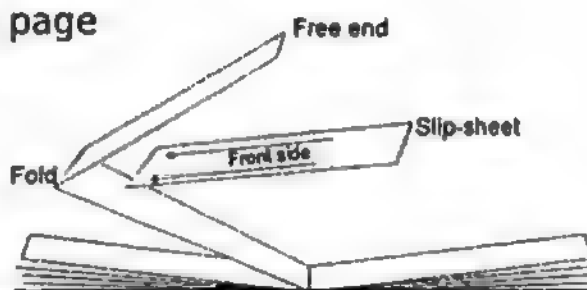
Inverted Foldout slip-sheet

Foldout slip-sheet

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1. Open the foldout page
2. Insert this sheet with
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4. Close the page and slip-sheet



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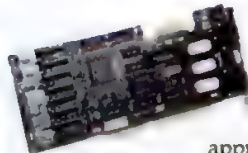
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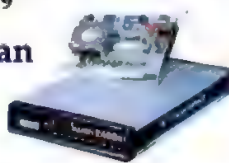
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When Mayor Suzanne Azar took office in June 1989, one of her first acts was to replace City Hall's ancient typewriters with state-of-the-art computer equipment.



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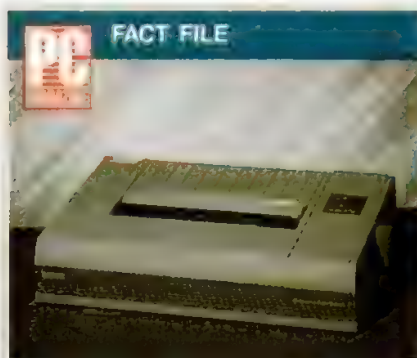
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one color ink jet cartridge. Hewlett-Packard charges just \$1,395 for the original PaintJet, but the PaintJet doesn't have the built-in DEC emulations that make this printer suitable for mixed-system environments.

The Companion Color Printer weighs just 10 pounds with either interface and measures 4 by 17.5 by 12.3 inches (HWD). The DEC-compatible emulation is DEC ANSI. The PC-compatible emulations are HP LaserJet Plus as well as the PaintJet.

The Companion Color Printer is rated



FACT FILE

DEC LJ250 Companion Color Printer
DEC LJ252 Companion Color Printer
 Digital Equipment Corp., 146 Main St., Maynard, MA 01754; (800) 344-4825, (508) 493-5111.
List Price: \$1,780 (for either unit); black ink cartridges, \$31; three-color ink cartridges, \$39; clay-coated fanfold paper, \$18 per 250-sheet pack.
Standard Warranty: One year on parts and labor
Dimensions (HWD): 4 x 17.5 x 12.3 in.
Weight: 10 lbs.
Emulations: HP LaserJet Plus, HP PaintJet, ANSI
In Short: DEC's LJ250 and 252 Companion Color Printers are re-packaged HP PaintJet ink jet devices that add ANSI and ReGIS compatibility for DEC or mixed DEC/PC environments

CIRCLE 673 ON READER SERVICE CARD

at 90 cps in text mode and achieved 62 cps on our speed test. The text is comparable in quality to the NLQ text of a low-end dot matrix printer. In graphics mode under the PaintJet emulation, the printer produced output at a rate of 1.1 graphics pages per minute. Both type and graphics that were produced by the Companion Color Printer look very nice but unfortunately fall short of laser quality.

As a printer test sheet, the DEC machine prints patches of 255 different colors, similar to a paint chip chart. We had no PC emulation test that took particular advantage of the printer's color printing abilities, but it seems every bit as capable as the PaintJet. The disposable thermal ink color cartridges print in seven colors at

PRINTERS

INK JET

180- by 180-dpi resolution and 255 colors at a resolution of 90 by 90 dpi.

The Companion Color Printer's standard typeface is Courier 10, which it can print at 10, 12, and 18 cpi in HP mode. Supported character features include superscript and subscript, bold, italics, single and double underlining, overlining, and strike-through.

As with the PaintJet, the Companion Color Printer's printhead flies back and forth across the page almost noiselessly while printing. You'll get best results using clay-coated paper, which costs \$18 per pack of 250 letter-size fanfold sheets. That price may seem high at first, but you'll probably be using the printer for occasional graphics jobs, not for dashing out quick memos or your daily list of things to do. You can also use the printer to create transparencies.

The first time you install the ink cartridges, it may take a few minutes to figure out what to do and why, but the process is simple and clean. After taking the cartridges out of their sealed containers, you simply prime them using a small pump built into the printer, clean the tips on a surface built in for that purpose, and then insert them into their compartment where the magic of color ink jet printing takes over. The black cartridges are good for 1 million characters and cost \$31. The three-color cartridges are rated for 325,000 characters and list at \$39.

The control panel on the Companion Color Printer has few indicators and buttons, employing LED lights and membrane buttons to allow control of the paper-feed mechanism and selection of emulation. There are no font cartridge options or different print modes, so there isn't a need for many controls.

If you like the HP PaintJet but want to use it in a mixed DEC/PC environment, buy the Companion Color Printer. If you like the PaintJet and want to use it in a pure PC environment, buy the PaintJet.

Epson EPI-4000

by M. David Stone

Epson America Inc. has a well-deserved reputation for selling quality printers at reasonable prices, and you would expect no less from the Epson EPI-4000, the company's first 300-dpi ink jet. That being the



EDITOR'S CHOICE

- Canon BJ-10e
- HP DeskJet 500

With the price of personal laser printers falling and the capabilities of dot matrix printers growing ever greater, ink jet printers are securing their own survival by taking on applications that other printers can't do as well, can't do as inexpensively, or can't do at all. Each of the machines in this diverse lineup does at least a reasonably good job of fulfilling its intended mission, but two of the printers stand out from the rest, both for their excellent print quality and for their relatively wide appeal.

Measuring a trim 2.2 by 12.3 by 8.5 inches (HWD), the \$499 Canon BJ-10e will fit into a briefcase and still leave enough room for a notebook laptop. Canon lists the optional battery pack at \$50 and rates battery operation at 30 pages per charge. The Kodak Diconix 150 Plus, which earned an Editor's Choice in last year's printer roundup (see Printer Blockbuster Issue, November 14, 1989), measures even smaller and also accepts a battery pack, but the BJ-10e beats the Diconix hands down in text output quality, while only adding another 0.85 in total weight. In fact, you'd be hard-pressed if you tried to tell BJ-10e text output from that of a laser printer.

The \$995 Hewlett-Packard DeskJet Plus earned an Editor's Choice last year for its impressive output quality, its versatility, and its 2-ppm speed (see Printer Blockbuster Issue, November 14, 1989). The Hewlett-Packard DeskJet 500 not only retains these characteristics but also adds new internal fonts and accommodates new options, including Epson FX-80 and IBM Proprinter emulation cartridges. Best of all, it does all this at an aggressive list price of only \$729. If you need laser output and features but your budget says \$500 to \$600, the DeskJet 500 is your best bet. However, if you can make the jump in street price to about \$900, you'll be happier with the real thing.



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PRINTERS INK JET

FONTS & FEATURES		Epson EPI-4000	
		HP LaserJet Series II	
		Helvetica	Times
		Underline Sub Super Italic Bold	Underline Sub Super Italic Bold
8/9-point			
10-point			
12-point			
14-point			
Scalable			
		Epson LQ	
		Bold	Italic
		Sub Super	Underline
10 cpi			
12 cpi			
Compressed			
Proportional			

case, the \$1,999 list price of this 64-nozzle printer leads one to wonder just what is so special about this particular ink jet. The answer lies with its ability to handle 11- by 17-inch paper, a feature you won't find in a laser printer at anywhere near the EPI-4000's \$1,999 price.

Setting up and using the EPI-4000 is extremely easy. Like many of this year's printers, the unit offers a control panel with

built-in menu selections. Although the two-character LED shows options in codes rather than words, most of the codes are explained by a chart pasted on the printer itself. The only time we needed to look at the manual was to find the command for initializing the ink cartridge. For those who need more help, the manual is clearly and concisely written and contains ample illustrations.

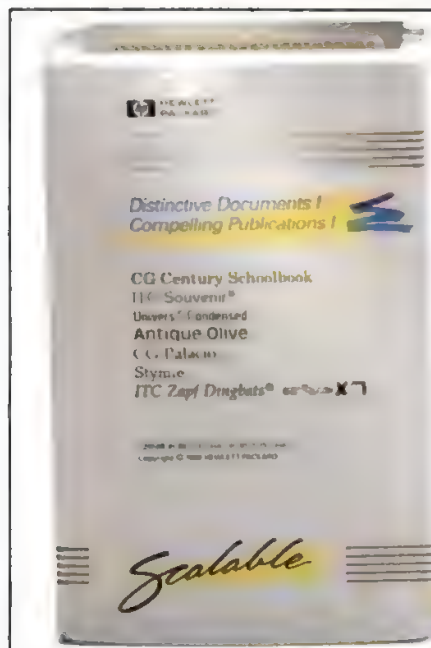
The EPI-4000 emulates the LaserJet Series II, Epson LQ-2500, and Epson FX-1050 but comes with a meager collection of typefaces: Courier, Courier Bold, Prestige, and Line Printer. The flat-bed design accepts paper as wide as 11.8 inches and features a 100-page paper tray at the front along with an adjustable, single-page feed. The exit tray, which is located at the rear of the printer, accommodates a maximum of 30 pages. Epson rates maximum paper weight at 24 pounds and offers an external push tractor for continuous paper as a \$149 option.

The only other option Epson sells for this printer is an upgrade to 2.5MB RAM for \$899. The company reports that third-

party options for adding a Coax or Twinax connector are also available through Epson dealers. Both parallel and serial connectors come with the printer.

As with other ink jet printers, output quality with the EPI-4000 varies with the paper it's using. Epson recommends cotton-bond or sulfite paper, and the manual claims that copier paper is also a good choice. However, in our tests, there was a significant difference between print quality with the cotton-bond paper that the company provided and the copier paper that we normally use. When we printed in laser-quality mode on cotton-bond paper, our unit generated text that was as crisp and clear as that of the best 300-dpi laser printers. Text that was produced in draft mode was no less crisp but it was lighter. With copier paper, characters show noticeable bleeding, leaving them as roughly formed as the NLQ text of a bad dot matrix machine.

Graphics quality also varied significantly with different types of paper. The cotton-bond paper retained the detail and shading you'd get from a laser printer, but the copier paper lost the finer detail and crisp line edges. Experience with other ink



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the wealth. Without downloading. Without using up memory. Because the typefaces are printer resident.

With HP scalable typeface cartridges you get more than great typeface styles. You get them in the exact

PRINTERS INK JET

jet printers suggests that other brands of copier paper may yield better-looking output, as may mimeograph and laser bond paper. To be sure you're using the most appropriate paper for your particular printing needs, you'll want to test a few sample pages in the printer before buying large quantities of any paper.

One other quality issue for ink jet printers is the smearing of ink. The EPI-4000 approaches this potential disaster in two ways. First, it dries the ink by heating the page slightly after printing but before stacking it on the output tray. Second, once dried, the ink stays dry. Even if you wet the ink and rub it, the smearing is minimal, which makes the printer not only appropriate, but desirable for envelopes and mailing labels.

Unfortunately, the heating step slows the printer down. With the top cover up, you can watch the self-cleaning printhead spray ink on the paper, and you can't help but be impressed with the speed. After printing, however, the heating step can take almost as long as the time it takes to actually print.

During our tests, the printer's graphic speed suffered even more because of a bug

in the LaserJet Series II emulation. Rather than printing a graphic while ignoring a permanent header macro loaded in the printer's memory, the EPI-4000 printed the header, fed a page, heated the page, then printed the graphics on the next page and heated it. All of this took about 63 seconds per graphic, yielding a graphic speed of 1.0 gppm. With its Epson LQ emulation, which didn't have the problem of feeding an extra page, graphics speed was 0.8 ppm.

Laser-quality text speed clocked in at about 40 cps in LaserJet Series II mode and 41 cps for Epson LQ mode. Draft speed managed about 64 cps for LaserJet Series II mode and 66 cps for LQ mode. In Epson's preferred page-per-minute rating, this translates to 1.4 ppm for quality text, and 2.2 to 2.3 ppm for draft. Should Epson ever engineer a faster drying ink, look for future versions of the printer to speed up dramatically.

All told, the EPI-4000 fills an important niche. If you need to print only on 8.5- by 11-inch paper, you're obviously far better off with a low-price laser. In fact, even the



Epson EPI-4000

Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; (800) 922-8911.

List Price: \$1,999; upgrade to 2.5MB RAM, \$899; external push tractor, \$149; replacement ink cartridge, \$35.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 20 x 22 x 31 in.

Weight: 39.6 lbs.

Emulations: HP LaserJet Series II, Epson LQ, Epson FX

In Short: The Epson EPI-4000 offers few compelling features but produces laser-quality output on paper as large as 11 by 17 inches, a task no similarly priced laser printer can handle.

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PERFORMANCE TESTS: INK JET PRINTERS

The ink jet footrace was close, but HP's entries were the overall speed winners, with their DEC sibling running a close third. Epson's near-laser entry finished fourth while Canon's 4.6-pound portable BubbleJet showed it was built more for size than speed.

Of the six ink jet printers in this roundup, four of them are based on Hewlett-Packard ink jet printing technology. The HP DeskJet 500 and PaintJet XL are monochrome and color ink jet printers, respectively. The DEC LJ250 and LJ252 are really updated HP PaintJets that contain DEC ANSI and PCL emulations as well as PaintJet emulations. The other two ink jet printers are manufactured by Canon and Epson.

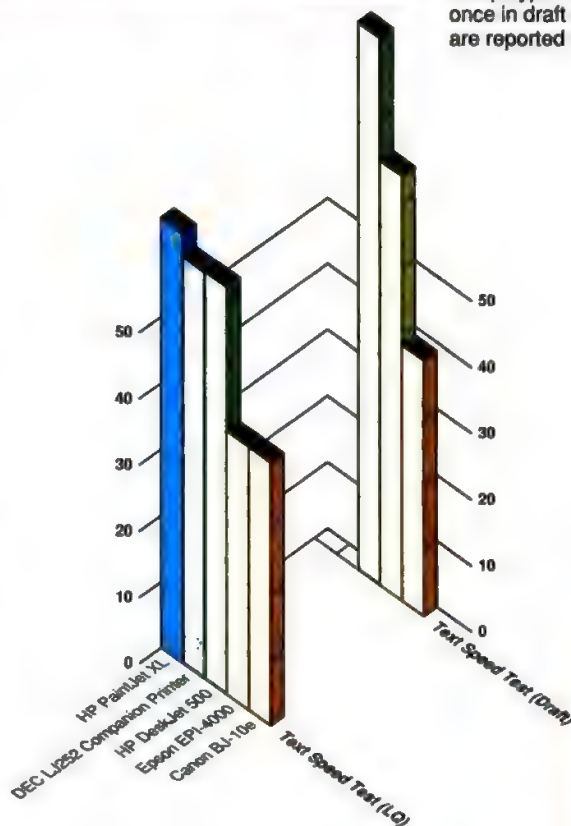
The Canon BJ-10e has a built-in Proprietary 24-pin emulation and is designed as a battery-powered portable printer. Weighing in at just 4.6 pounds with batteries installed, the BubbleJet had no problem handling our Proprietary emulation test. In order to run the PC Labs two-page text speed test though, we had to install the optional sheet feeder. With it, the BJ-10e ran at 40 cps in LQ mode and 39 cps in draft mode. The reason for this speed similarity is that the "draft" mode on the machine is really an "economy" mode. The printer sprays less ink on the page but moves the printhead at the same speed, regardless of which mode the printer is in.

The DEC LJ252 (the LJ250 was not tested) ran at 62 cps in its tested HP LaserJet Series II emulation, which is slower than the 78 cps the PaintJet was tested at in our 1987 Printer Blockbuster Issue (November 10, 1987). The reason for the speed difference between these two seemingly identical printers is the overhead for the PCL emulation under which the LJ252 was tested. The PaintJet was not tested with PCL emulation three years ago.

The Epson EPI-4000 was the closest thing to a laser printer. With a resolution of 300 dpi, output quality was as good as most lasers. The EPI-4000 also exceeded its rated speed on our text speed test, running at 1.4 (40 cps) and 2.2 (65 cps) ppm for quality and draft print, respectively. The EPI-4000 was also the most compatible of the ink jets with the LaserJet Series II. Unfortunately, the Epson did exhibit one compatibility problem on our PCL torture test, which specifically tests permanent macros. We were unable to resolve the problem with Epson at the time of this writing.

The other two ink jet printers from Hewlett-Packard, the PaintJet XL and DeskJet 500, both support PCL level 3 with extensions. The PaintJet XL is a larger format version of the PaintJet and supports 11- by 17-inch paper. The DeskJet 500, is similar to the LaserJet with 300 dpi resolution. It has a draft mode allowing it to pump out an extra 21 cps on our speed test—83 cps in draft versus 62 cps in letter quality mode. Both HP printers exhibited the fastest times for ink jet machines on our graphic speed test, with the PaintJet XL performing at 1.8 gppm while the DeskJet 500 performed at 1.6 gppm.

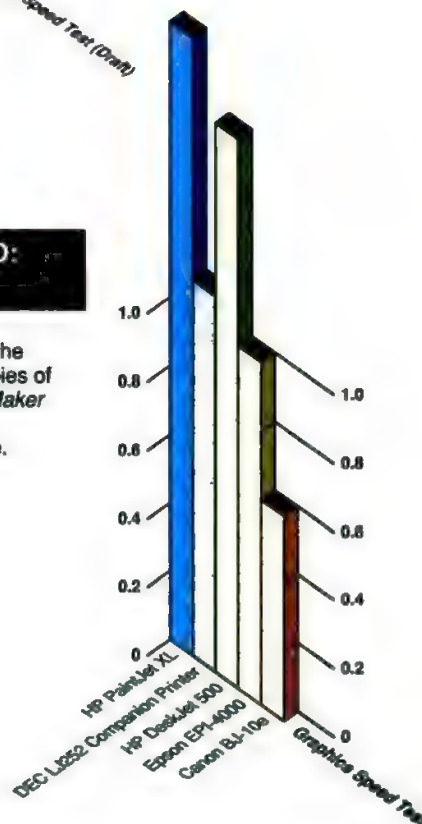
INK JET TEXT SPEED: COMPOSITE VIEW



(Taller bars indicate better performance.)

INK JET GRAPHICS SPEED: COMPOSITE VIEW

The Graphics Speed test measures the time it takes to send and print two copies of a graphic image created using PageMaker and Microsoft Windows. Results are reported in graphics pages per minute.



The HP PaintJet XL and the DEC LJ252 do not have a draft mode.

PRINTERS INK JET

HP LaserJet III may have a lower street price than the EPI-4000. But if you need 300-dpi resolution, LaserJet Series II compatibility, and the ability to print on 11- by 17-inch paper, the EPI-4000 is a good choice. If you're on a tight budget, it may be your only choice.

HP DeskJet 500

by Alfred Poor

With a list price of just \$729, the new Hewlett-Packard DeskJet 500 gives you most of the benefits of a personal laser at about half the price. Like the Hewlett-Packard DeskJet Plus, which earned an Editor's Choice in last year's printer roundup (see Printer Blockbuster Issue, November 14, 1989), the DeskJet 500 prints at 300 dpi, operates nearly silently, and offers attractive fonts and strong expansion capability. The most notable improvements in this latest incarnation are the additional resident fonts, more-aggressive pricing, a more smudge-proof ink, and an unprecedented three-year warranty.

You give up a few features when you choose this printer over a laser. For example, print speed for the highest-quality text is just over 2 pages per minute—half that of a personal laser. When printing on standard paper, you also lose something in print quality: The ink tends to spread slightly, though this problem can be solved by using special, clay-coated paper.

On the other hand, the DeskJet gives you many features you would expect in a

with a 20-pitch Courier that stands a full 12 points high. This font comes across as extremely compressed and a little difficult to read, but it does give almost 20 percent more characters per inch than a LaserJet Line Printer font. The three different Courier fonts are also available in landscape mode, and a 5-pitch Courier is available in portrait.

Further, you get good paper handling. The paper tray can hold up to 100 sheets of paper, and you can load it with either letter- or legal-size sheets. You can also manually feed a standard, No. 10 business envelope. And, like a laser, the printer is whisper-quiet in operation.

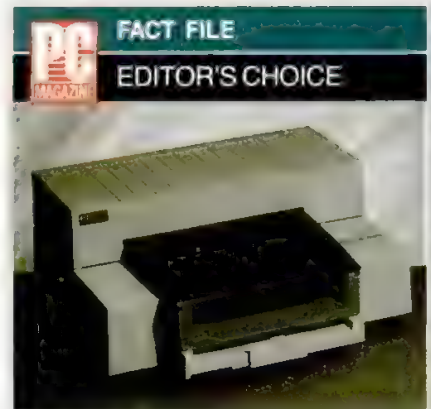
There are some more features on the DeskJet 500 that you don't get with a typi-

**The \$729 DeskJet 500
provides many benefits
of a personal laser at
about half the price—
it prints at 300 dpi,
operates nearly
silently, and offers
attractive fonts and
expansion capability.**

cal laser printer. For example, the front panel makes it a snap to select among the Courier fonts, though you'll need to use software commands to select others, and a draft mode speeds up printing by nearly 50 percent.

You might be surprised to find that the cost of operation is about the same as with a laser, or even a bit higher. The ink cartridges contain the printhead, so maintenance problems are kept to a minimum. While these cartridges have a list price of just \$20, compared with more than \$100 for most laser cartridges, the ink cartridges are rated for only about 500 pages of printing. This works out to nearly 4 cents per page, excluding paper cost, which is at the high end of even personal laser per-page figures.

One bit of good news about the DeskJet



HP DeskJet 500

Hewlett-Packard Co., 19310 Prunefield Ave., Cupertino, CA 95014; (800) 752-0900.

List Price: \$729; 128K memory cartridge, \$95; 256K memory cartridge, \$175; Epson FX-80 emulation cartridge, \$79; IBM Proprinter emulation cartridge, \$79; font cartridges, \$79 to \$140; downloadable fonts, \$79; replacement ink cartridges, \$20.

Standard Warranty: Three years on parts and labor.

Dimensions (HWD): 8.0 x 17.3 x 14.8 in.

Weight: 14.3 lbs.

Emulations: HP LaserJet Plus.

In Short: Ideal for those who want laser features but balk at laser prices, the HP DeskJet 500 offers 2 ppm and letter-quality performance at about half the price of a personal laser printer.

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500 is that HP has reformulated the ink used in the cartridges. The older ink was prone to smearing and running if it got wet. This new ink is far more durable; a wet finger smeared across a printed page comes up clean, and the text remains unsullied. The new cartridges are now available for all DeskJet models.

The HP DeskJet 500 is a little slower and a bit less sharp in print quality than a personal laser printer, but at half the price, it still offers plenty of fonts and quiet operation. It is well suited for a variety of general applications and is likely to steal buyers away from the 24-pin dot matrix market as well as the low-end laser market.

FONTS & FEATURES

HP DeskJet 500

HP LaserJet Plus			
	Helvetica	Times	Courier
	Underline	Underline	Underline
	Sub-Super	Sub-Super	Sub-Super
	Italic	Italic	Italic
	Bold	Bold	Bold
8/9-point			
10-point			
12-point			
14-point			
Scalable			

laser printer. There are 10- and 16.7-pitch Courier fonts that can print in both medium and bold weights. The 10-pitch Courier also comes with a companion italic font. You also get 12-pitch Letter Gothic and proportional CG Times fonts, both of which can print in medium or bold and come with italic versions. And for really wide spreadsheets, the DeskJet 500 comes

HP PaintJet XL

by Alfred Poor

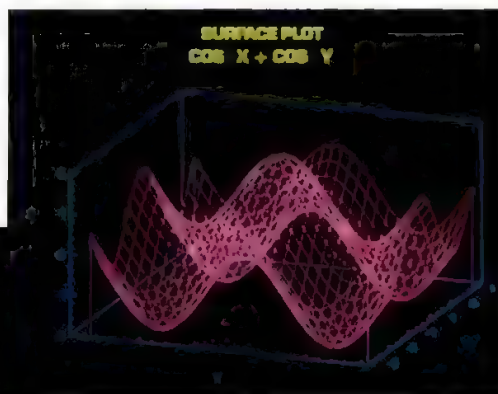
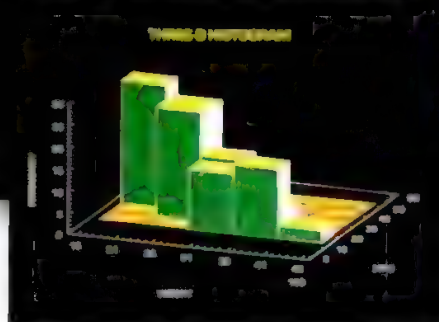
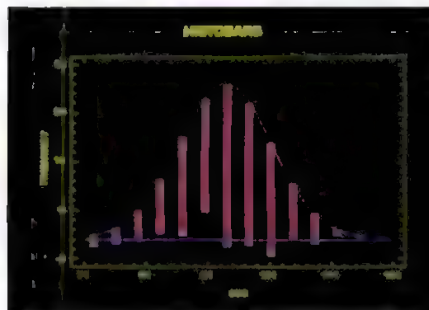
An ink jet printer with a list price of \$2,495 may seem a bit presumptuous, but Hewlett-Packard's PaintJet XL may just be able to carry it off. For those in the market for an excellent personal color printer, the \$1,395 HP PaintJet is still available (see "King Color: New Printers Banish Black and White," May 31, 1988). The PaintJet XL targets more-demanding applications

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Canon Inc. Tokyo, Japan

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On a desk, with its optional 30-sheet paper feeder, it's an ideal personal printer. As a single-sheet portable with its optional rechargeable battery pack, it weighs a remarkable 4.6 pounds and prints on a variety of paper. Moreover, the BJ-10e emulates the IBM[®] Proprinter[™] X24E, so you can use a wide range of applications software.

How fast is it? It prints 83 characters per second and won't slow down when printing in bold or various type sizes. It even handles complicated graphics such as the scanned-in image printed here. And, it's so quiet it can be used in the middle of the night with someone asleep just a few feet away.

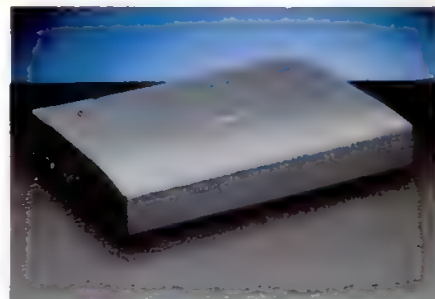
Plus you never have to worry about maintenance because it uses an economical pop-in BJ cartridge, containing the print head and ink supply, which prints approximately 700,000 characters (HQ mode). But best of all, the BJ-10e works everywhere you could possibly need it, fitting neatly into a briefcase.

The BJ-10e Bubble Jet. What other printers print on a desk, it prints anywhere.

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with its greater speed, automatic sheet feeder, and ability to print on paper as large as 11 by 17 inches. This printer can handle jobs that much of the higher-priced competition can't.

The PaintJet uses ink cartridges much like those used in the PaintJet and HP DeskJet printers—each cartridge contains the print nozzles. Thus the printhead is replaced each time you change cartridges, which keeps maintenance problems to a minimum. If the print nozzles should indeed clog, however, there is a handy cleaning station built right into the printer case so that you can quickly purge and wipe the nozzles clean, restoring them to full action. The 30 nozzles yield a resolution of 180 dpi.

The printer takes four ink cartridges at a time, which are loaded in a large hopper that moves them back and forth across the paper. Each of the four spaces is color coded so you know where to place the black, cyan, yellow, and magenta cartridges. The ink coverage is smooth and even, but the printer offers a special two-pass "presentation mode" designed to lay the ink down in a thicker and more even layer for use on overhead transparencies. The black cartridge is rated at 1,100 pages of text, and the color cartridges are rated at 500 pages of graphics with 13-percent coverage. At \$30 per cartridge, the per-page costs are extremely attractive compared with those

PRINTERS INK JET



HP PaintJet XL
Hewlett-Packard Co., 19310 Pruneridge Ave.,
Cupertino, CA 95014; (800) 752-0900.
List Price: \$2,495; optional font cartridge, \$225;
HP-GL/2 emulation cartridge with 2MB page
buffer, \$995; black or color replacement ink
cartridges, \$30.
Standard Warranty: One year on parts and
labor.
Dimensions (HWD): 9.5 x 29.7 x 19.1 in.
Weight: 39 lbs.
Emulations: HP LaserJet Plus.
In Short: This ink jet printer generates vivid color
graphics at high speeds, making it ideal for
shared use of high-volume color applications. Its
ability to handle 11- by 17-inch paper helps to
make it a bargain.

CIRCLE 672 ON READER SERVICE CARD

The one weakness of this printer is its meager font capabilities. It comes with a 10-pitch Courier font and 12- and 18-pitch Letter Gothic fonts, all of which can be printed in either medium or bold weights. There are no italic and no proportional fonts, though an optional \$225 cartridge covers some of those omissions.

You probably won't buy this printer for text applications, however. The PaintJet XL is a graphics machine, and its 33.6 second time on the graphics speed test, for a rate of 1.8 gppm, makes it one of the fastest color print options available. It's also ruggedly built. HP designed it for 20 to 60 pages per day, making it well suited for shared use or high-volume applications. And, for those who also need plotter output, Hewlett-Packard offers an HP-GL/2 emulation cartridge with a 2MB page buffer as a \$995 option.

Compared with less-expensive color dot matrix offerings, the PaintJet XL is fast, with excellent output and flexible paper handling. It also costs only about 25 percent as much as thermal-transfer color page printers and offers lower per-page costs and faster output with only a small loss in output quality. If you have a serious need for lots of printed color output, the HP PaintJet XL is an affordable, cost-effective, and capable solution.

FONTS & FEATURES

HP PaintJet XL

HP LaserJet Plus

	Helvetica			Times			Courier			Line Printer		
	Underline	Sub Super	Italic	Underline	Sub Super	Italic	Underline	Sub Super	Italic	Underline	Sub Super	Italic
8.9-point												
10-point												
12-point												
14-point												
Scalable												

of color page printers.

There is more, however. Unlike most color printers, the PaintJet XL can handle paper wider than 8.5 inches. The 200-sheet paper tray can be adjusted to accept paper as large as 11 by 17 inches, making it possible to print poster-size charts and graphs. While you can use just about any paper in the printer, HP recommends using special ink jet paper available from the company in order to obtain best results. When we used the paper supplied with the printer, the print quality was excellent and thereby lived up to HP's claim.

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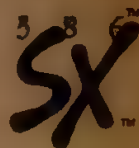
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With EMS	62K* *Minimum	Concurrent Send & Receive	Coax SDLC

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As laser printer prices plummet, dot matrix printer manufacturers find themselves competing for niches in a no-excuses, feature-rich market.



BY TOM UNGER

It used to be that laser printers were the province of the rich or well-connected. The rest of us got along on 9- and 24-pin dot matrix printers. We put up with snailslow output, noise, and nlq type whose acronym might better have stood for: *Never Letter Quality*. Try as they might, impact printer makers could come close to, but never achieve, the superior output provided by lasers. We sighed, we wished, and we suffered.

But a funny thing happened on our way to the dot matrix marketplace. Lasers became cheap—cheap enough to compete

DOT MATRIX

with 24-pin dot matrix printers. Cheap enough to make those of us who thought laser output was forever out of reach think again.

ASSESSING YOUR NEEDS

If you produce only correspondence, then your dot matrix days are probably over for good. For the rest of us, the manufacturers of the new or improved dot matrix printers reviewed here are banking on the continuing pervasiveness of those tasks most laser printers cannot perform.

Want technology that can make carbons for you? No laser can do that, but just about all dot matrix printers can print up to three layers—some can print up to six layers. Want to print addresses on envelopes and labels, correspondence on cut-sheet stationery, and spreadsheets on perf paper without having to reload your output media? Lasers can't simultaneously provide all these options, but many of the dot matrix printers in our roundup can—and they can do it at a street price that no laser can match.

This year, both Okidata and Panasonic have joined NEC in producing 24-pin printers that list for under \$500. With street prices running in the \$250 to \$300 range, these versatile machines make a fine complement to any laser printer. These ultra-competitive prices will allow you to eat your laser-printer cake and have your dot matrix, too—giving you the best of both printing worlds without bankrupting you in the process. Now you can do high-quality correspondence and high-speed forms printing for less than the price of a laser printer sold two years ago.

Even the less-expensive dot matrix printers include features not available in low-end models a year ago. In an effort to provide more options for buyers and to separate themselves from the pack, many 9-pin models, like the ALPS ASP1600 priced at \$299, and the Star Micronics XR-1000 Multi Font priced at \$499 (\$50 color kit optional), include items like zero-clearance forms tear-off (the printer allows the last printed page to be torn off *without* losing a blank page to a form feed), intelligent paper-parking, front-panel menuing, and font cartridge slots.

Additional emulations, color kits, and LCD readouts—like those found on AEG Olympia's NP 80SE (\$499) and NP 136SE (\$699), and Citizen's 200GX (\$299)—are now items that are necessary in order to insure the survival of the dot matrix printer as a species.

ONCE MORE INTO THE NICHE!

This year, you're more likely to find surprises in the specialty dot matrix printer market. Epson, for example, the manufacturer who long ago brought you the diminutive MX-80, has added to its line the beefier DFX-8000, a 63.9-pound, 9-pin printer that Epson rates at 1,066 cps—speed that rivals laser printers' at 11 ppm in draft mode. At \$3,699 it won't beat the price of any low-cost laser, but you won't be able to find a laser printer that has this kind of forms-crunching muscle. And if \$3,699 seems too steep for a dot matrix printer, you might take a look at Genicom's \$2,595, 18-pin model 3840, which produces a whopping 8.4 ppm.

For those interested in the high-end of



Ultimately, the
advances in dot matrix
printer technology
will serve only to
stave off the
narrowing of a market
fast being overtaken
by laser printers
performing traditional
dot matrix tasks.

high-speed output, see our sidebars on Mannesmann Tally's \$5,999 645, whose output is measured in lines per minute—450 lpm, to be exact—and CIE America's \$9,995 monster, the CI-1000, which gallops along at 760 lpm.

Another area of burgeoning versatility for dot matrix printers is color. Last year, only 15 of the dot matrix printers that we reviewed came with or offered color as an option, and we relegated those printers to their own separate section. This year, in the face of increasing competition from laser printers, 24 dot matrix printers offer color output, and this time we have included them in our regular black-and-white-only dot matrix section.

Now no longer low-quality curiosities, color capable dot matrix machines offer a vastly less expensive alternative to color page printers. Our reviewers found a lot to like in the \$499 Citizen GSX-140, a 24-pin printer that, when augmented by its \$59 color kit, produced outstanding color graphics with hardly any distortion in the primary or pastel colors. It may not rival color PostScript printer output, but a street price in the \$285-to-\$300 range makes this printer and its ilk hard to pass up where price must be taken into consideration. And if you print a lot of preliminary color drafts, at only a penny or so per page a low-cost color dot matrix printer may end up saving you a ton of money.

Another little-known factor that may affect your choice: the lowly printer ribbon. Okidata, for instance, attributes the output quality of its revamped Microline 393 Plus printer (\$1,499) to improved inking abilities. The company uses re-inking fabric ribbons and has managed to both decrease the incidence of smudges while at the same time increasing character darkness.

Another lesser-known factor affecting graphics quality in dot matrix printers is printhead positioning technology. Okidata takes an automotive turn, and puts a rack-and-pinion drive in its Microline 390 Plus and Microline 391 Plus (\$699 and \$949, respectively). These alternative drive mechanisms produce exceptionally high-quality graphics because of their precise positioning of the printhead versus standard belt drives.

THE END OF AN ERA

Ultimately, the advances in dot-matrix technology will serve only to stave off the narrowing of a market fast being overtaken by laser printers performing traditional dot matrix tasks. Advances in hardware like a new Pentax printer that contains a continuous forms laser engine allowing tractor-feeding of single-part forms in a laser environment, and improvements in software, such as Avery's \$100 *LabelPro* that permits easy printing of labels on laser printers, will enable lasers to encroach even further on dot matrix territory.

The bottom line? Unless you're on a tight budget, producing multipart forms, or printing spreadsheets on very wide paper, your dot matrix days may be numbered. But if you still need the forms-handling flexibility that is *de rigueur* among dot matrix printers nowadays, you'll find lots to choose from in the following pages.

DOT MATRIX

AEG Olympia NP 80-24E

\$499

24-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED 105 cps
GRAPHICS SPEED: 1.0 gppm
GRAPHICS TIME 1 min. 2 sec.



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Gothic Bold Under



AEG Olympia NP 80SE

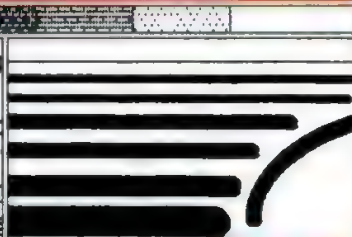
\$499

9-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED 126 cps
GRAPHICS SPEED: 1.5 gppm
GRAPHICS TIME 0 min. 38 sec.



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NLQ Pica Bold Under



AEG Olympia NP 136SE

\$699

9-pin wide-carriage monochrome dot matrix printer

TEXT SPEED 145 cps
GRAPHICS SPEED: 1.5 gppm
GRAPHICS TIME 0 min. 40 sec.



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ALPS ASP1600

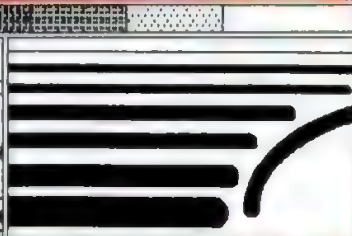
\$299

9-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED 59 cps
GRAPHICS SPEED: 0.5 gppm
GRAPHICS TIME 1 min. 53 sec.



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ALPS Allegro 500

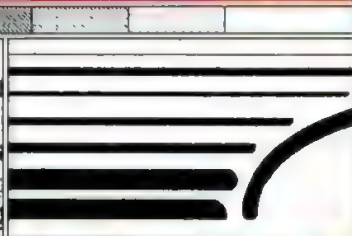
\$499

24-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED 113 cps
GRAPHICS SPEED: 0.5 gppm
GRAPHICS TIME 1 min. 54 sec.



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Courier Bold Under



ALPS Allegro 500XT

\$799

24-pin wide-carriage monochrome dot matrix printer

TEXT SPEED 138 cps
GRAPHICS SPEED: 0.5 gppm
GRAPHICS TIME 1 min. 49 sec.



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Elite pitch Bold Under



A

Do anything and you would

For 25 years, Epson® printers have placed ink on paper with fine-crafted precision and ever-increasing speed. Each character as impressive as the last. A feat that Epson 24-pin printers have



2 Year Warranty

*Just one more measure of how
dependable your Epson printer will be.*

accomplished 15 trillion times over.

Today, dot matrix is the most widely used printing technology in business. Of course, the most widely used dot matrix printers are made by Epson. The very



15 trillion times be good at it, too.

company that invented them two decades ago.

Epson printers—from dot matrix to laser to inkjet—are the epitome of reliability. But where there is brawn, there is also a brain. Consider Epson's ingenious SelecType™ control panel and

skillful SmartPark™ paper handling. These and other conveniences make operating an Epson as flawless as the printing.

We could go on. But you already have 15 trillion reasons to choose an Epson.

Engineered For The Way You Work.™

EPSON

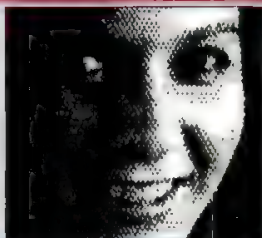
PRINTERS

DOT MATRIX

Brother M-1909

\$699

18-pin wide-carriage color-capable dot matrix printer; \$78 dealer-installed color kit optional



TEXT SPEED: 129 cps
GRAPHICS SPEED: 0.7 gppm
GRAPHICS TIME: 1 min. 27 sec.

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Prestige Bold Unde



Brother M-1924L

\$949

24-pin wide-carriage color-capable dot matrix printer; \$78 dealer-installed color kit optional



TEXT SPEED: 122 cps
GRAPHICS SPEED: 0.7 gppm
GRAPHICS TIME: 1 min. 21 sec.

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Draft Bold Underlin
Draft Bold Underlin



Bull Compuprint 4/22

\$499

9-pin narrow-carriage monochrome dot matrix printer



TEXT SPEED: 117 cps
GRAPHICS SPEED: 1.4 gppm
GRAPHICS TIME: 0 min. 43 sec.

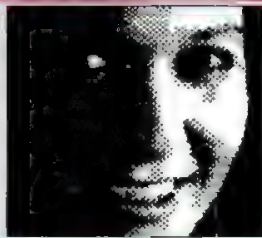
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NLQ 10CPI Bold Unde



Bull Compuprint 4/23

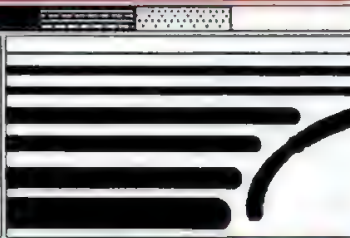
\$699

9-pin wide-carriage monochrome dot matrix printer



TEXT SPEED: 116 cps
GRAPHICS SPEED: 1.4 gppm
GRAPHICS TIME: 0 min. 44 sec.

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Bull Compuprint 4/24

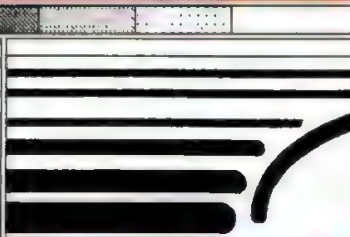
\$995

24-pin wide-carriage monochrome dot matrix printer



TEXT SPEED: 113 cps
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME: 0 min. 55 sec.

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Bull Compuprint 4/40

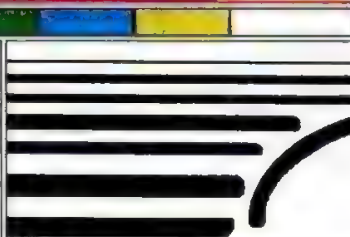
\$1,245

9-pin narrow-carriage color-capable dot matrix printer; color ribbon optional, \$21



TEXT SPEED: 154 cps
GRAPHICS SPEED: 0.5 gppm
GRAPHICS TIME: 1 min. 52 sec.

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PPica Bold Underlin
NLQ Pica Bold Unde



Italian masters have always realized that innovative details are destined to rise above the commonplace.



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PCS 386SX	80386SX	16	3 1/2"
M386SX	80386SX	20	3 1/2" & 5 1/4"



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CIRCLE 168 ON READER SERVICE CARD

PRINTERS DOT MATRIX

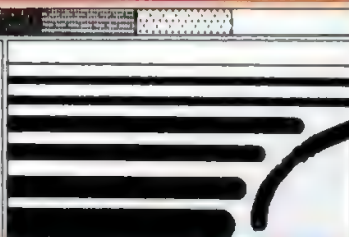
Bull Compuprint 4.43

\$1,995

9-pin wide-carriage monochrome dot matrix printer; automatic top-feeder attachment standard



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TEXT SPEED: 142 cps
GRAPHICS SPEED: 1.6 gppm
GRAPHICS TIME 0 min. 39 sec.

Bull Compuprint 4.34

\$1,995

24-pin wide-carriage color-capable dot matrix printer; color ribbon optional, \$21



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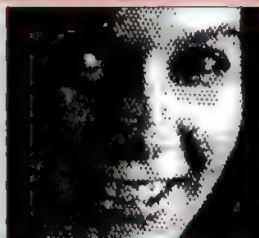


TEXT SPEED: 165 cps
GRAPHICS SPEED: 0.7 gppm
GRAPHICS TIME 1 min. 26 sec.

Bull Compuprint 4.68

\$2,345

18-pin wide-carriage color-capable dot matrix printer; color ribbon optional, \$36



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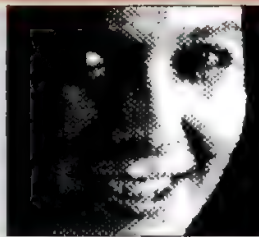


TEXT SPEED: 192 cps
GRAPHICS SPEED: 0.7 gppm
GRAPHICS TIME 1 min. 25 sec.

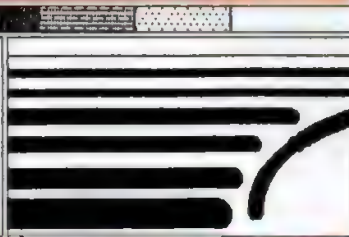
CIE C-5000

\$1,995

18-pin wide-carriage dot matrix printer; rated at 540 cps



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TEXT SPEED: 250 cps
GRAPHICS SPEED: 2.7 gppm
GRAPHICS TIME 0 min. 22 sec.

Citizen GSX-140

\$495

24-pin narrow-carriage color-capable dot matrix printer; color kit optional, \$59



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TEXT SPEED: 94 cps
GRAPHICS SPEED: 0.6 gppm
GRAPHICS TIME: 1 min. 36 sec.

Citizen 2000X

\$299

9-pin narrow-carriage color-capable dot matrix printer; color kit optional, \$59



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Pica Bold Underli
Roman Bold Underl



TEXT SPEED: 108 cps
GRAPHICS SPEED: 0.4 gppm
GRAPHICS TIME: 2 min. 25 sec.



Many users. Multiple forms. One printer.

TI's 8900 Series — cost-cutting shared printers for forms and more.

Now you can get a single shared printer that can do the job of several machines — print up to nine-part forms, letters, labels, envelopes and other documents. The 8900 Series is a solution that not only makes sense, it saves money.

Starting at only \$2,345,* an 8900 Series printer is one of the fastest shared printers in its class, with more features and a size that's slightly larger than your personal printer.

Because of its impressive list of paper-handling features — zero tear-off, paper parking, top-of-form sensing and more — an 8900 Series printer can be used in all kinds of applications and shared easily. It automatically adjusts

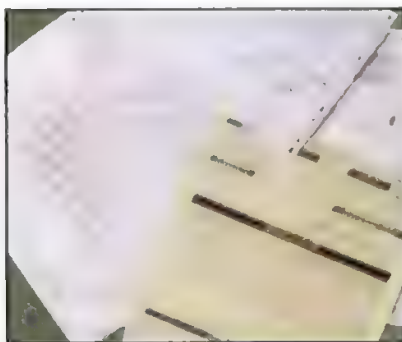
to form width, length and thickness, making form waste and misaligned paper a thing of the past.

You can also say goodbye to complicated controls. Now you can select options like print quality (ranging from

letter-quality 100 cps to Rapid Print 600 cps), font styles, menu status and more by simply touching a Powerkey™ button. Some models even print color graphs or highlight reports with up to seven colors.

What's more, with its 16,000 pages-per-month** output capability, an 8900 Series printer is so reliable it can even replace some line printers.

All this adds up to a cost-cutting printer solution you won't find anywhere else. For more information, call 1-800-527-3500.

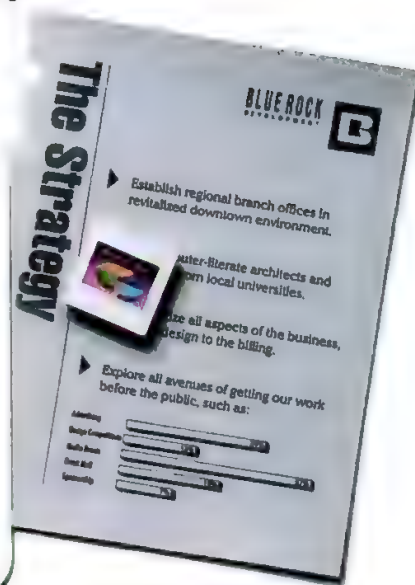
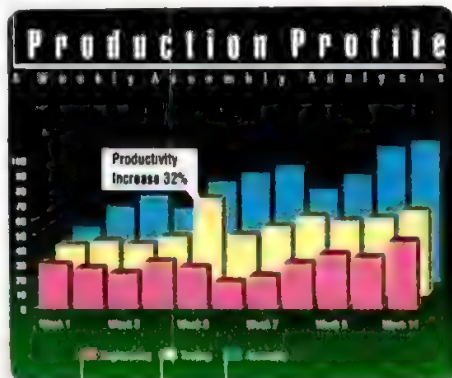


TI's 8900 Series prints a variety of forms — and more.

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Applause.



Bravos. Cheers. Hurrahs.

We found APPLAUSE II to be easier to work with than either Harvard Graphics or Freelance Plus, and faster than the Windows-based products.

INFOWORLD
JUNE 11, 1990

APPLAUSE II handles charting, drawing, and on-screen presentations with a fluidity and ease-of-use not found in either Harvard Graphics or Freelance Plus—and it does all this in a mere 512K.

PC MAGAZINE MARCH 13, 1990

PC/COMPUTING APRIL 2, 1990

It's graphical. It's interactive. It makes excellent use of the mouse. Best of all, it abandons the stodgy fill-in-the-form approach to creating charts that is used by Freelance, Harvard and 35mm Express.

The critics are raving about its ease-of-use and intuitive "Windows"-like interface. And how APPLAUSE II™ turns data into 37 different chart types automatically. In black and white or 3.6 million colors. Creating everything from dazzling overheads, slides and on-screen presentations to



high-impact hard copy.

To find out more, call 1-800-437-4329 ext. 1308 for a free video and eye-opening demonstration disk.*

And see why the critics are giving APPLAUSE II a standing ovation.

 Ashton-Tate®

C-Tech ProWriter C-240**\$449**

9-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED: 113 cps
 GRAPHICS SPEED: 1.1 gppm
 GRAPHICS TIME: 0 min. 53 sec.



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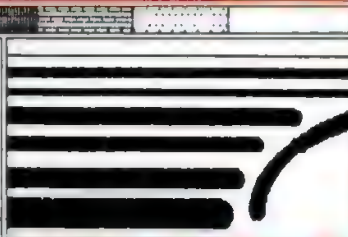
**C-Tech ProWriter C-245****\$559**

9-pin wide-carriage monochrome dot matrix printer

TEXT SPEED: 110 cps
 GRAPHICS SPEED: 1.1 gppm
 GRAPHICS TIME: 0 min. 55 sec.



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**C-Tech C-510****\$639**

24-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED: 111 cps
 GRAPHICS SPEED: 0.4 gppm
 GRAPHICS TIME: 2 min. 29 sec.



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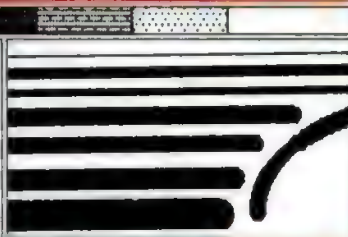
**C-Tech C-515****\$749**

24-pin wide-carriage monochrome dot matrix printer

TEXT SPEED: 110 cps
 GRAPHICS SPEED: 0.4 gppm
 GRAPHICS TIME: 2 min. 29 sec.



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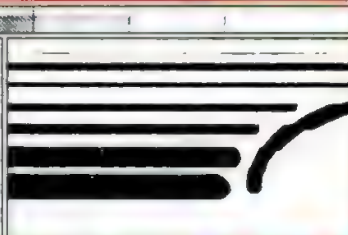
**C-Tech C-610 Plus****\$799**

24-pin narrow-carriage monochrome dot matrix printer; rear-to-front flat-bed paper-feed design

TEXT SPEED: 113 cps
 GRAPHICS SPEED: 0.4 gppm
 GRAPHICS TIME: 2 min. 22 sec.



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**C-Tech C-610C Plus****\$899**

24-pin narrow-carriage color dot matrix printer

TEXT SPEED: 112 cps
 GRAPHICS SPEED: 0.4 gppm
 GRAPHICS TIME: 2 min. 25 sec.



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Monitors, Modems,



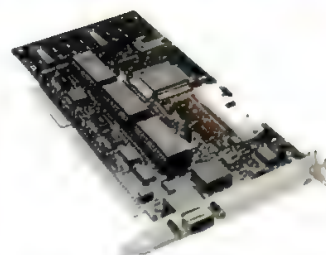
PC Brand 1024 x 768 Super VGA Monitor

\$399

When you compare the state-of-the-art design, superb engineering and technical specs, full 1 year warranty, and the low, low price, we're sure you'll agree-the PC Brand Super VGA monitor is the best value on the market.

	PC Brand	VS.	MultiSync 3D
Price	\$399		\$1049 Retail / \$629 Avg. Discount
Dot Pitch	0.29mm		0.28mm
Scanning Frequency:			
Horizontal	up to 38KHz		up to 38KHz
Vertical	up to 90Hz		up to 90Hz
Maximum Resolution	1024 x 768 interlaced		1024 x 768 interlaced
Display Colors (Analog)	unlimited		unlimited
Display Area!	13" diagonal		13" diagonal
Power Consumption	75 Watts		90 Watts
Dimensions (DXWXH)	14.8" x 14.5" x 14.2"		16" x 14" x 14.3"
Adaptability	VGA, 1024 x 768, 8514A		VGA, 1024 x 768 8514A, plus older modes

PC BRAND



PC Brand Super VGA Cards up to 1024 x 768 Resolution x 256 Simultaneous Colors

(1024 x 768 x 256 requires 1024K)

- Performs at maximum resolution on both interlaced or non-interlaced monitors
- Enhanced graphic resolution up to 1024 x 768
- 256 colors at 1024 x 768 on 16 bit card with 1MB RAM
- Auto-sensing 8/16 bit bus interface
- High speed video memory operation
- Up to 1 MB of RAM available on 16 bit card
- Software drivers for most popular application packages

8 bit card with 256K

\$79

16 bit card with 256K

\$119

16 bit card also available with 512K & 1024K. Call for special prices.

Mice, and Memory.

PERIPHERALS AT UNBEATABLE PRICES!

RAM Memory Upgrades

We offer Upgrades for all the most popular Systems including: AST, COMPAQ Desk Pro, COMPAQ System Pro, EPSON, HP IBM PS/2, NEC, TOSHIBA and More.

(Call our sales dept. with your exact system and model number)

Dip/Sipp/Simm Modules

256K Dip 80/100ns
\$3.00

256K Sipp 80/100ns
\$28.00

256K Simm 80/100ns
\$28.00

1 MB Dip 80/100ns
\$8.00

1 MB Sipp 80/100ns
\$85.00

1 Mb Simm 80/100ns
\$85.00

PC Brand Mouse Windows 3.0 Bundle

We've combined our high performance, 300 DPI, ultra high resolution mouse with Microsoft's Windows 3.0 at an unbelievable price.

\$86



- Maximize your existing hardware
- Integrate text, numbers, and graphics with ease
- Switch between tasks more efficiently
- Create rich, distinctive documents with a minimum of time and effort

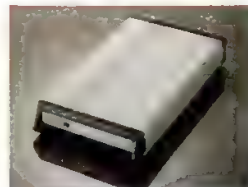
**PC Brand Mouse
sold separately....\$39**

PC Brand Internal & External Modems

- 100% Hayes compatible
- Auto dial, auto answer
- Compatible with CCITT and Bell communications standards
- MNP-5 Data Compression option giving 4800 BPS performance in a 2400 BPS modem
- Automatic data standard and speed adjustment

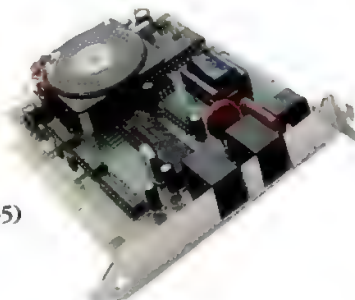
2400 BPS External

\$99
(with MNP-5)
\$139



2400 BPS Internal

(with Software)
\$75
(w/Software & MNP-5)
\$99



Call for Information and pricing on our full line of Fax cards and other ultra high speed communications peripherals.

These prices are typical of what you'll find on thousands of peripheral and software items we carry in stock and ready for immediate shipment. call us today with your special needs.

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1-800-PC BRAND

TEL:1-800-722-7263 FAX:1-800-722-7392

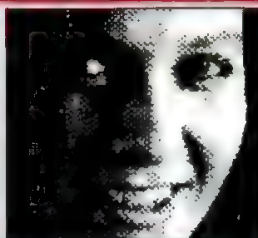
PC Brand, Inc. 954 W Washington St., Chicago, IL 60607
International Fax #312-633-2888 International Voice #312-226-5200 We are open Mon. thru Fri.: 7am to 7pm; Sat.: 8am to 4pm Central Time MasterCard, VISA, Discover, PC Brand Direct Advantage MasterCard, Checks and Approved P.O.s are Accepted. Prices and specifications subject to change. PCM 9-19A CIRCLE 386 ON READER SERVICE CARD

PRINTERS DOT MATRIX

C-Tech C-645

\$1,395

28-pin wide-carriage monochrome dot matrix printer



Man's mind cannot
of events in their
but the desire to
is implanted in m
10CPI Bold Underl
NLQ 10CPI Bold Und



TEXT SPEED: 168 cps
GRAPHICS SPEED: 1.5 gppm
GRAPHICS TIME: 0 min. 39 sec.

Dataproducts 9056

\$649

9-pin narrow-carriage monochrome dot matrix printer



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TEXT SPEED: 136 cps
GRAPHICS SPEED: 1.3 gppm
GRAPHICS TIME: 0 min. 47 sec.

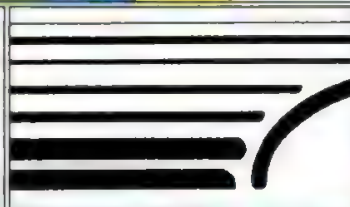
Dataproducts 9044

\$1,199

24-pin wide-carriage color-capable dot matrix printer



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Draft Bold Underl
Elite pitch Bold Unde



TEXT SPEED: 104 cps
GRAPHICS SPEED: 0.3 gppm
GRAPHICS TIME: 2 min. 53 sec.

DEC LA 70 Personal Printer

\$499

9-pin narrow-carriage monochrome dot matrix printer



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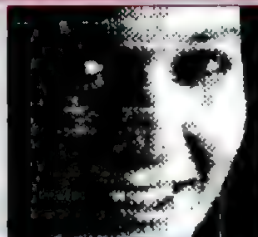


TEXT SPEED: 105 cps
GRAPHICS SPEED: 1.0 gppm
GRAPHICS TIME: 0 min. 59 sec.

DEC LA 75 Companion Printer

\$835

9-pin narrow-carriage monochrome dot matrix printer



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NLQ 10CPI Bold Und

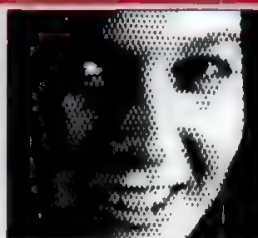


TEXT SPEED: 142 cps
GRAPHICS SPEED: 1.4 gppm
GRAPHICS TIME: 0 min. 42 sec.

DEC LA 324 MultiPrinter

\$2,095

24-pin wide-carriage color-capable dot matrix printer; color supported under DEC RISTOS only



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is implanted in m
10CPI Bold Underline Compressed
Proportional 10CPI B



TEXT SPEED: 162 cps
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 11 sec.

Get what you want, without giving up what you have.

DisplayWrite 5 for DOS.

DisplayWrite® 5 has what it takes to give users and buyers alike the power, speed and flexibility they've been asking for.

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BOARDSKI MARKET APPRAISAL OBJECTIVES

I. To determine the market potential for product, the BoardSki.

a) Can the overall concept in sports be there a particular purchase this product?

II. To evaluate the market's response to the BoardSki.

a) Will present owners purchase the BoardSki?

b) Is the proposed price of the BoardSki?

III. Advertising Strategy.

a) In what medium are prospects reached - television, radio, newspaper, etc.

b) What is a ballpark figure for a product rollout expected in order to achieve the results of user group?

c) What are the results of user group?

d) Should ads be geared towards promoting a purchase decision?

IV. Distribution of product.

a) Should the BoardSki only be marketed through sporting goods stores and outlets?

b) Should an on-site rental chain be established at beaches, and roller parks and resorts?

c) What are the pros and cons of retail distribution?

BOARDSKI REPORT # 24
Breakdown of West Coast Market by Age Group: Male

"Television is the best medium for reaching our target market."
"The largest buying potential is males between the ages of 5 and 24."
"A related sportswear line is being suggested for consideration."

Age Group	Annual Income	Own BoardSki	Own Skateboard	Own Snowboard
5-12	00.00	27%	36%	0%
12-18	2,500.00	37%	20%	15%
19-24	20,000.00	29%	5%	3%
25-34	32,000.00	11%	0%	0%
35-49	38,000.00	5%	0%	0%

ANALYSIS:

Due to the proximity of the ocean, the mountains, and a large number of parks, the metropolitan Los Angeles represents the ideal market to introduce the BoardSki. The age group with the largest buying potential is males between the ages of 5 and 24.

Surveys indicate that television is the best medium for reaching this market, perhaps by utilizing cable stations with an all-music format. Other possible media buys include FM radio stations and college newspapers.

On a related note, a line of sportswear has been suggested, marketed mainly to the parents of the 5 to 12 age group. Once a theme for the product has been established, items for the product line could be developed around a clothing line such as swimwear, t-shirts, sweatshirts, and winter nylon pullovers have been proposed.

PROJECT OVERVIEW

CONCEPT

Altusport is a new, all-season sportswear line. It's one place of sporting fun in any environment. To whip down your skateboard wheels, and strap on your snowboard down

PROBLEM

Altusport is a new, all-season sportswear line. It's one place of sporting fun in any environment. To whip down your skateboard wheels, and strap on your snowboard down

SCHEDULING

Altusport is a new, all-season sportswear line. It's one place of sporting fun in any environment. To whip down your skateboard wheels, and strap on your snowboard down

Smart.



The Fast-Refresh Magnavox Super VGA/60 Monitor Is A Sight For Sore Eyes.



Up till now, no matter how good your lighting, no matter how good your computer, if you spent any length of time in front of a Super VGA Monitor, your eyes probably suffered. It's time to get smart. Get the new Magnavox Super VGA/60, a sight for sore eyes.

Other competitive monitors display Super VGA images updated at 56Hz. That's so slow, it causes image flicker. Which can cause eye-strain and fatigue. The Magnavox Super VGA/60 is the first Super VGA display that updates the 800x600 image at 60Hz.

A critical difference that produces a more legible, steadier, flicker-reduced image for comfortable viewing.

But that's not the only fine feature to look for. Magnavox uses a superior CRT. An ultra fine 0.28mm pitch screen, that outperforms the 0.31mm CRT found in most competitive products. Plus, this monitor is designed with a MTBF of 50,000 hours. Twice as long as the leading product in the industry.

The Magnavox Super VGA/60 Monitor. Clarity and quality. Any way you look at it, that's very smart.

MAGNAVOX

Smart. Very smart.®

*The Magnavox Super VGA/60 (model 60M320) conforms to VESA/60 manufacturing guidelines for 800x600 displays operating at 60Hz refresh rate. It will operate with any graphic adapter which conforms to the VESA/60 timing. Compatible adapters include the Magnavox 9AV800 or equivalent, like Sigma — VGA Legend, ATI — VGA Wonder Plus and VGA Edge-16.

PRINTERS

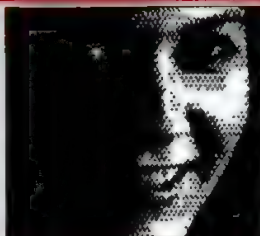
DOT MATRIX



Epson DFX-8000

\$3,699

9-pin wide-carriage monochrome dot matrix printer; rated at 1,066 cps; accepts up to 6-part forms



Man's mind cannot grasp
of events in their com
but the desire to find
is implanted in man's
Pica Bold Underline
NLQ Pica Bold Under



TEXT SPEED: 324 cps
GRAPHICS SPEED: 1.7 gppm
GRAPHICS TIME: 0 min. 35 sec.



Epson LQ-850

\$749

24-pin narrow-carriage monochrome dot matrix printer



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Draft Bold Underline
Proportional Bold Under



TEXT SPEED: 132 cps
GRAPHICS SPEED: 2.0 gppm
GRAPHICS TIME: 0 min. 29 sec.

Epson LQ-860

\$949

24-pin narrow-carriage color dot matrix printer; color ribbon optional, \$28



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Proportional Bold Under



TEXT SPEED: 128 cps
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 11 sec.

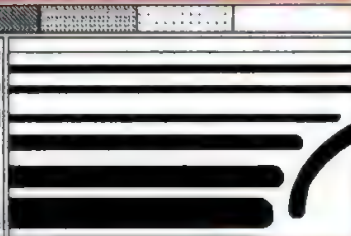
Epson LQ-1010

\$649

24-pin wide-carriage monochrome dot matrix printer



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TEXT SPEED: 81 cps
GRAPHICS SPEED: 1.4 gppm
GRAPHICS TIME: 0 min. 43 sec.



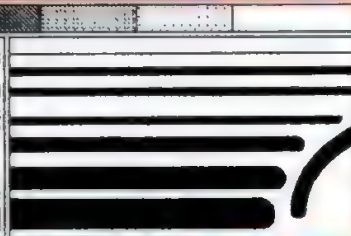
Epson LQ-1050

\$1,099

24-pin wide-carriage monochrome dot matrix printer



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Proportional Bold Under



TEXT SPEED: 128 cps
GRAPHICS SPEED: 2.0 gppm
GRAPHICS TIME: 0 min. 30 sec.

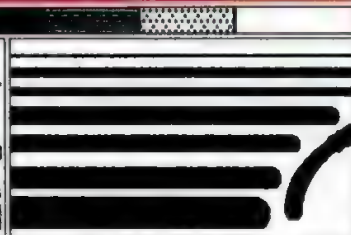
Facit B1200

\$269

9-pin narrow-carriage monochrome dot matrix printer



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10CPI Bold Underline
NLQ 10CPI Bold Under



TEXT SPEED: 74 cps
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 19 sec.

Have you heard our



Adobe Systems ... NCP
 7902 □ *Adobe Type Manager for Windows and Microsoft Windows 3.0*—Clean up that jagged type with Adobe Type Manager and Windows 3.0. Two hot programs for one great price. Specify media size \$149.

□ 3 1/2" format available from us. Specify when ordering.
 □ package includes both 5 1/4" and 3 1/2" disks.
 □ 3 1/2" format available from manufacturer by request. Call us for details.
 CP—copy-protected; NCP—not copy-protected.

The four-digit number next to each product is the product's ITEM NUMBER. Please refer to this number when ordering. Thank you.

SOFTWARE

We only carry the latest versions of products. Version numbers in our ads are current at press time.

Products listed here in red are Microsoft Windows Applications.



Corel Systems ... NCP
 5506 □ *CorelDRAW! 1.2*—The world's leading PC illustration software now comes with even more value: CorelTRACE, over 100 typefaces, over 300 clip-art images, a Pantone license—all bundled in for free \$329.

Adobe Systems ... NCP

- 6591 □ *Illustrator Windows 1.0* \$279.
- 7547 □ *Adobe Type Manager for Windows* 59.
- 7902 □ *Adobe Type Manager for Windows and Microsoft Windows 3.0* 149.
- 6590 □ *Streamline Windows 1.0* 229.
- 7392 □ *Adobe PostScript Cartridge* 249.
 (Entire Adobe Type Library, from 1 to 133 is available. Call for more information.)
- Aldus ... NCP**
- 1332 □ *PageMaker 3.01* 499.
- Alpha Software ... NCP**
- 5104 □ *Alpha Four 1.1* 319.
- Application Techniques ... NCP**
- 1214 □ *Pizazz Plus 2.0* 69.
- ASD Software ... NCP**
- 7847 □ *Planisoft 1.0* 145.
- Ashton-Tate ... NCP**
- 4450 □ *dBASE IV 1.1* 499.
- Asymetrix ... NCP**
- 7384 □ *Toolbook 1.0 for Windows* 309.



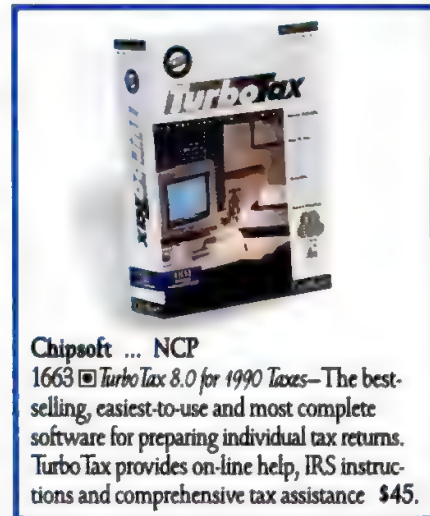
ASD Software ... NCP
 7847 □ *Planisoft 1.0*—Coordinate agendas, find available time-slots for appointments, keep track of deadlines & priorities, distribute tasks, optimize resources, share information between PCs & Macs over any LAN. \$145.

Avery ... NCP

- 6006 □ *Label Pro 1.0* 49.
- 7336 □ *Label Pro 1.0 for Dot Matrix* 49.
- Bitstream ... NCP**
- 7568 □ *FaceLift 1.0* 59.
- *Collections: Newsletters, Flyers, Books & Manuals, Reports and Proposals, Presentations or Spreadsheets* each 129.
- *Fontware* each 89.
- Borland International ... NCP**
- 7357 □ *Turbo C++ 1.0 Professional* 159.
- 7356 □ *Turbo Pascal Professional 2nd Ed.* 179.
- 6242 □ *Quattro Pro 1.0* 325.
- 1514 □ *Paradox 3.0* 469.
- Broderbund ... NCP**
- 1434 □ *New Print Shop (NCP)* 39.
- ButtonWare ... NCP**
- 6419 □ *PC-File 5.0* 89.
- Caere ... NCP**
- 6004 □ *OmniPage 386 2.1* 599.
- Central Point ... NCP**
- 5039 □ *PC Tools Deluxe 6.0* 89.
- 5038 □ *Copy II PC 5.0* 27.

Checkfree

- 6360 *CheckFree (electronic checking svcs)* \$25.
- Chipsoft ... NCP**
- 1663 □ *TurboTax 8.0 for 1990 Taxes* 45.
- CompuServe**
- 7546 *DOS Membership Kit* 23.
- Concentric Data Systems ... NCP**
- 6575 □ *R & R Relational Report Writer 3B* 109.
- Corel Systems ... NCP**
- 5506 □ *CorelDRAW! 1.2* 329.
- Custom Applications ... NCP**
- 7474 □ *Freedom of Press 2.2* 255.
- Data Storm ... NCP**
- 4798 □ *PROCOMM PLUS 1.1* 65.
- DCA ... NCP**
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- 5611 □ *Crosstalk for Windows 1.1* 129.
- Delrina Technology ... NCP**
- 7351 □ *PerFORMPRO 1.0 for Windows* 299.
- Fifth Generation Systems ... NCP**
- 7725 □ *Direct Access 5.0* 59.
- 2762 □ *Mace Utilities 1990* 99.
- 7795 □ *Disklock 1.0* 109.
- 3950 □ *Fastback Plus 2.1* 119.
- FNN Data Broadcasting**
- 7005 □ *NewsReal 1.0* 99.
- FormWorx ... NCP**
- 5810 □ *FormWorx with Fill & File 2.5* 85.
- 7311 □ *Form Publisher for Windows 1.2* 145.
- Fox Software ... NCP**
- 6188 □ *FoxPro 1.02* 489.
- Franklin Software ... NCP**
- 7071 □ *Language Master 2.0* 59.
- 7416 □ *Language Master 3.0 for Windows* 59.
- Funk Software ... NCP**
- 2228 □ *Sideways 3.3* 52.
- 7380 □ *P.D. Queue 1.0 (print spooler)* ... 55.
- Generic Software ... NCP**
- 2265 □ *Generic CADD Level 3 1.1.3* ... 225.
- Great American Software ... NCP**
- 4880 □ *One Write Plus Acct. Sys. 2.06* . . 179.
- 5825 □ *Money Matters 1.0* 55.
- Harvard Associates ... NCP**
- 2324 □ *PC Logo 3.0* 59.



Chipsoft ... NCP
 1663 □ *TurboTax 8.0 for 1990 Taxes*—The best-selling, easiest-to-use and most complete software for preparing individual tax returns. TurboTax provides on-line help, IRS instructions and comprehensive tax assistance \$45.

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Hillgraeve ... NCP	
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IBM ... NCP	
6599	☐ Current 1.1 239.
Individual Software ... NCP	
6222	☐ Resume Maker 1.1 29.
Inset Systems ... NCP	
7298	☐ Hijaak 2.0 99.
7300	☐ Inset Plus Hijaak 125.
Intuit ... NCP	
2426	☐ Quicken 3.0 39.
Isogon ... NCP	
7478	☐ FontSpace 2.0 59.
Laser Go ... NCP	
7635	☐ Go Script Plus 3.0 189.
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6882	☐ PrintCache 2.3 99.
Lord Publishing ... NCP	
5191	☐ Ronstadt's Financials 1.02 75.
Lotus ... NCP	
5417	☐ 1-2-3 3.1 call
5653	☐ 1-2-3 2.2 349.
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MECA ... NCP	
4603	☐ Andrew Tobias' Tax Cut-1990 Taxes 49.
7002	☐ Home Lawyer 1.0 69.
2798	☐ Managing Your Money 6.0 135.
Microcom ... NCP	
7649	☐ Virex 1.1 79.
6234	☐ CarbonCopy Plus 5.2 119.
Micrografx ... NCP	
7683	☐ Charisma 1.0 349.
Micro Logic ... NCP	
6787	☐ Info Select 1.1 55.
Microlytics ... NCP	
2731	☐ GOfar 2.0 45.
Microsoft ... NCP	
7882	☐ Productivity Pack for Windows ... 45.
7010	☐ Windows 3.0 99.
7388	☐ Project for Windows 1.0 469.
7387	☐ PowerPoint for Windows 1.0 329.

2904	☐ Works 2.0 \$99.
2901	☐ Word 5.0 209.
6195	☐ Word for Windows 1.1 329.
2856	☐ Excel 2.1 329.
2894	☐ QuickBASIC 4.5 69.
2853	☐ C Compiler 6.0 339.
Multisoft ... NCP	
4925	☐ PC-Kwik Power Pak 1.5 79.
Nolo Press ... NCP	
2982	☐ WillMaker 4.0 39.
Norton-Lambert ... NCP	
4928	☐ Close-Up Customer/Terminal 3.0 135.
4929	☐ Close-Up Support/ACS 3.0 165.
PC Globe ... NCP	
5902	☐ PC Globe 4.0 39.
5900	☐ PC USA 2.0 39.
Personics ... NCP	
4384	☐ Ultravision 2.0 79.
7048	☐ Monarch 1.0 (Data Mgmt. Tool) . 319.
PowerUp ... NCP	
7860	☐ Calendar Creator Plus 45.
7858	☐ Express Publisher 2.0 89.



PDQueue
Lotus 1-2-3 add-in that saves time by spooling Sideways & Allways output to hard disk & printing in the background 55.

Sideways
Funk Software ... NCP
2228 ☐ Sideways 3.3—Rotates your spreadsheets 90° as they print \$52.

Precision Software ... NCP	
6600	☐ Superbase 4 for Windows 1.2 .. 469.
Qualitas ... NCP	
7539	☐ 386MAX 5.0 75.
Quarterdeck ... NCP	
6422	☐ QRAM 1.0 49.
3221	☐ Expanded Memory Mgr. 386 5.1 . 59.
3220	☐ DESQView 2.3 79.
4586	☐ DESQView 386 5.1 129.
Reality Technologies ... NCP	
6572	☐ WealthBuilder 1.1 145.
Reference Software ... NCP	
4396	☐ Grammatik IV 1.0 52.
7483	☐ Grammatik for Windows 1.0 52.

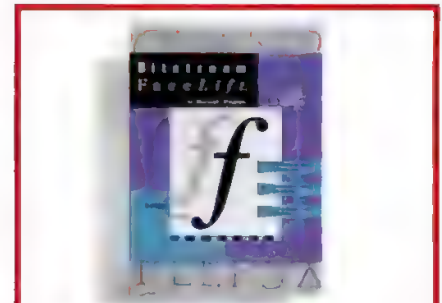
1-800/243-8088

MMC

PC Connection
6 Mill Street
Marlow, NH 03456

780M

SALES 603/446-7721 FAX 603/446-7791



Bitstream ... NCP

7568 ☐ FaceLift 1.0—Fast & easy-to-use, scales screen & printer fonts to any size. 13 type-faces to give you professional documents instantly. Superb laser output & near laser-quality output for dot matrix printers . \$59.

Revolution Software ... NCP	
4480	☐ VGA Dimmer 2.01 (screen saver) . 29.
RightSoft ... NCP	
4155	☐ RightWriter 4.0 55.
Samna ... NCP	
5799	☐ Ami Professional 1.2 309.
Softlogic Solutions ... NCP	
3542	☐ Software Carousel 4.0 55.
Software Publishing ... NCP	
3499	☐ PFS:First Publisher 3.0 99.
3478	☐ PFS:First Choice 3.02 105.
3496	☐ Professional Write 2.2 179.
3482	☐ Harvard Graphics 2.3 359.
Spinnaker ... NCP	
7604	☐ Plus for Windows 1.0 289.
Symantec ... NCP	
3152	☐ Norton Commander 3.0 105.
6397	☐ The Norton Backup 1.1 105.
3146	☐ The Norton Utilities 5.0 125.
3425	☐ Q&A 3.0 229.
3431	☐ Timeline 4.0 469.



Software Publishing ... NCP

3482 ☐ Harvard Graphics 2.3—New version! Built-in drawing tools and other new features make this superior graphics and charting program a top performer. Graphically the best choice \$359.



FormWorx ... NCP

7311 ☐ Form Publisher for Windows 4.2—Desktop publishing designed especially for creating professional-quality forms. Use unique object-oriented design techniques & import graphics. Over 600 forms included!.. \$145.

Makes unpacking



Microsoft ... NCP

7882 ☐ **Productivity Pack for Windows**—Includes: Learning Windows—a comprehensive tutorial, Working Smarter—on-line productivity tips, and Quick Troubleshooter—helps solve common Windows problems \$45.

Systems Compatibility ... NCP

- 6564 ☐ Software Bridge 4.1 79.
TIMESLIPS ... NCP
 2987 ☐ Timeslips III 4.0 195.
 6994 ☐ PercentEdge 1.0 69.
Timeworks ... NCP
 6253 ☐ Publish-It! 1.1 115.
TOPS ... NCP
 6675 ☐ TOPS Network Bundle 3.0 159.
 3720 Flashcard 2.1 (AppleTalk network card; 1 year warranty) 155.
Touchstone Software ... NCP
 7420 ☐ Check It 3.0 89.
Traveling Software ... NCP
 5179 ☐ LapLink III 3.0 95.
True BASIC ... NCP
 3561 ☐ True BASIC 2.1 52.
Vericomp ... NCP
 6771 ☐ Memory Master 1.1 45.
Volkswriter ... NCP
 6246 ☐ Volkswriter 4 1.02 109.



Touchstone Software ... NCP

7420 ☐ **Check It 3.0**—Diagnostic software will help find and get rid of system problems. Run over 160 tests on all major system components. Results can be logged to disk or printer with suggestions on fixing simple troubles .. \$89.

West Lake Data Corp. ... NCP

- 7577 ☐ PC-FullBak+ 1.12 \$52.
 7574 ☐ PathMinder+ 1.0 79.
 7575 ☐ ValuePak (includes 4 programs) .. 69.
WordPerfect Corp. ... NCP
 7781 ☐ LetterPerfect 1.0 135.
 3804 ☐ WordPerfect 5.1 265.
 6685 ☐ DrawPerfect 1.1 279.
WordStar International ... NCP
 6791 ☐ WordStar Prof. 6.0 279.
Xerox ... NCP
 7796 ☐ Ventura Publisher for Windows 3.0 569.
XTREE ... NCP
 6161 ☐ XTreePro Gold 1.4 75.
ZSoft ... NCP
 7016 ☐ PC Paintbrush IV Plus 1.0 119.
 7014 ☐ PC Paintbrush Plus for Windows 1.12 89.

RECREATIONAL/EDUCATIONAL

Broderbund ... CP

- 5701 ☐ Where/Time Carmen Sandiego? . 32.
 5851 ☐ SimCity 33.

PC Globe PC USA



PC Globe ... NCP

- 5902 ☐ **PC USA 2.0**—Instant profiles on all 50 states and Puerto Rico, including maps, graphics, and data \$39.
 5900 ☐ **PC Globe 4.0**—Provides profiles of 177 countries. Exports to many programs .. 39.

Electronic Arts ... NCP

- 5804 ☐ Deluxe Paint II (Enhanced) 89.
HyperGlott ... NCP
 7849 ☐ Word Torture - French 29.
 7853 ☐ Word Torture - Spanish 29.
Microsoft ... NCP
 2858 ☐ Flight Simulator 4.0 39.
Penton Overseas ... NCP
☐ VocabuLearn/ce Levels I & II (French, Italian, German, Spanish, Russian, Hebrew and Japanese) each 39.
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 6023 ☐ Leisure Suit Larry III 39.
 6796 ☐ Codename: Iceman 39.
 6972 ☐ Conquests of Camelot 39.
Software Toolworks ... NCP
 6436 ☐ Hunt for Red October 20.
 4659 ☐ Chessmaster 2100 (CP) 35.
Stone & Assoc. ... NCP
 7564 ☐ Young Math (ages 5 to 8) 22.
 3439 ☐ 2nd Math (ages 7 to 16) 27.



Qualitas ... NCP

7539 ☐ **386MAX 5.0**—Powerful new MAXIMIZE feature finds and uses all the memory you paid for. Automatic install makes this industry-standard memory manager indispensable for all level of 386 users . \$75.

Toyogo ... NCP

- 7676 ☐ Go Master Deluxe 89.
True BASIC, Inc. ... NCP
☐ Kemeny/Kurtz Math Series. each 45.

HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

American Power ... 2 years

- 7108 APC Smart-UPS 400 339.
 6811 360SX (stand-by power source) ... 219.
 7107 450AT (stand-by power source) ... 279.
 7106 520ES (stand-by power source) ... 329.

AST Research ... 2 years

- 1299 SixPakPlus 384k C/S/P 179.
 6795 SixPak 286 512k 179.
 4107 RAMpage Plus 286 512k 419.

Boca Research ... 5 years

- 7001 BOCARAM/AT PLUS (0-8 Meg) (LIM 4.0 extended) 125.

- 7061 BOCARAM/XT 0K (0-2 Meg, LIM 4.0) 99.
 7135 TophAT (16-bit backfill 512K to 640K) 99.
 6998 I/O Board for AT 59.
 6999 I/O Board for Microchannel S/S/P . 109.
 6995 SuperVGA (800 x 600, 16/8 bit) ... 115.
 7026 1024 VGA (16 bit non-interlaced) .. 149.

Bravo Communications

- 7400 2 Pos. Laser Compatible Switch Box 109.
Brother International ... 1 year
 5787 HL-8e Laser Printer (HP2 comp.) . 1399.

Canon ... 1 year

- 7894 BJ-10e BubbleJet Printer (4.6 lb.) . 349.
 7896 Sheet feeder for BJ-10e 75.

CH Products ... 1 year

- 7341 Gamecard III Plus (for Microchannel PS/2s) 49.
 7340 Flight Stick (includes Falcon F-16) .. 49.
 7345 Rollermouse (Trackball) serial 85. bus 99.

Compuable ... 2 years

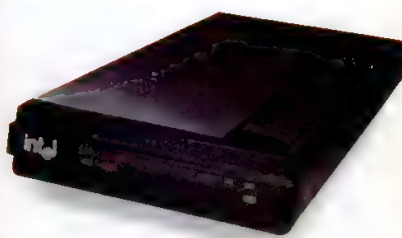
- 1604 2-Position switch box 25.

more pleasant to do?



Intel ... 5 years
Above Boards—FREE Quarterdeck QRAM and Manifest with any Above Board or piggyback, now through December 31, 1990! ... see Intel listing for prices.

- 4750 80387SX (16 MHz 80386SX CPU's) \$309.
- 2371 80387 (16 MHz 80386 CPU's) ... 349.
- 2372 80387-20 (20 MHz 80386 CPU's) 399.
- Kensington Microware ... 1 year**
- 7899 Expert Mouse serial... 119. bus... 129.
- Keytronic ... 3 years**
- 4518 101 Plus Keyboard ... 99.
- Kraft ... 5 years**
- 5800 3 button Thunder Joystick ... 29.
- 5802 Trackball ... 59.
- Logitech ... limited lifetime**
- 5464 C9 Mouse for PS/2's ... 69.
- 7768 C9 Mouse with Windows ... 149.
- 5151 HiREZ Mouse (C9) ... 85.
- 6029 Trackman (Trackball) serial 85. bus 89.
- 4297 ScanMan Plus (hand scanner) ... 185.
- Micron Technology ... 2 years**
- 7595 Intensify 2 Meg Expansion for HP LaserJet IIP or III ... 175.
- 7012 Beyond Memory Board for PS/2 Model 70 (2 Meg) ... 265.



Intel ... 5 years
7880 9600EX Modem—Provides ultra-fast data communications without sacrificing compatibility. Supports V.32 & V.42 9600 bps operation, as well as MNP Level/5 and Hayes compatible 2400/1200/300 bps modes . \$549.

- Curtis ... lifetime**
- 1708 Ruby-Plus SPF-2 Plus ... 65.
- 7358 Command Center ... 93.
- Glass Filter Plus (specify size) ... ea. 65.
- Datadesk ... 3 years**
- 6901 Switchboard ... 175.
- Epson ... 1 year**
We are an authorized Epson Service Center.
- 1906 FX-850 (80 col., 264 cps, 9 pin) ... call
- 1904 FX-1050 (136 col., 264 cps, 9 pin) ... call
- 5183 LQ-510 (80 col., 180 cps, 24 pin) ... call
- 1930 LQ-850 (80 col., 264 cps, 24 pin) ... call
- 1917 LQ-1050 (136 col., 264 cps, 24 pin) call
- 5184 LX-810 (80 col., 180 cps, 9 pin) ... call
- 1052 Printer-to-IBM cable (6 feet) ... 15.
- 7775 Equity LT-286e Laptop ... 1995.
- 7774 Equity LT-386SX Laptop ... 3069.
- Removable Hard Drives for Epson Laptops
- 7776 20 Meg ... 499. 7777 40 Meg ... 699.
- 5th Generation ... 1 year**
- 7157 Logical Connection Plus 512k ... 599.
- Hayes ... 2 years**
- 2307 Smartmodem 2400 ... 349.
- 7391 Ultra 9600 Modem ... 899.
- Hewlett-Packard ... 1 year**
- 6754 LaserJet III (w/toner) ... 1699.
- 6582 LaserJet IIP (w/toner) ... 1069.
- Intel ... 5 years**
- 6421 2400B MNP Internal Modem ... 199.
- 2352 2400B Internal Modem 2 (for PS/2) 249.
- 5119 2400 Baud External Modem ... 179.
- 6420 2400EX MNP Modem ... 229.
- 7880 9600EX Modem ... 549.
- 2346 Inboard 386/PC w/1 Meg (w/free Arm) 519.
- 4266 Above Board Plus 512k ... 369.
- 4267 Above Board Plus I/O 512k ... 399.
- 5336 Above Board Plus 8 2 Meg ... 599.
- 5342 Above Board Plus 8 I/O 2 Meg ... 629.
- 4272 Above Board 2 Plus 512k ... 469.
- 5396 Above Board MC 32 0k ... 359.
- 7782 SatisFAXtion ... 399.
- 7552 NetPort ... 489.
- MATH COPROCESSORS**
- 7385 80287XL (16 MHz 80286 CPU's) ... 199.



Intel ... 5 years
80287XL & 80287XLT Math CoProcessors—Runs up to 50% faster than other 80287 math chips. The 80287XL works in virtually every 80286-based PC, and the 80287XLT is made especially for Compaq LTE/286.. each \$199.

- Microsoft ... lifetime**
- 7597 Microsoft Mouse ... 89.
- 2897 Mouse with Paintbrush ... 109.
- 2898 Mouse with Windows 3.0 ... 149.
- MicroSpeed ... 1 year**
- 6007 PC-TRAC Trackball (includes a free copy of Welltris) serial ... 75. bus ... 85.
- Mouse Systems ... lifetime**
- 5997 Trackball (1 yr. wrnty.) serial 75. bus 85.
- 7878 PC Mouse III ... 99.
- NEC ... 2 years**
- 4799 Multisync 2A (VGA Monitor) ... 499.
- 5085 Multisync 3D Monitor ... 689.
- Orchid Technologies ... 4 years**
- 7512 ProDesigner VGA II (1024 x 768) ... 299.

- PC Power & Cooling ... 1 year**
- REPLACEMENT POWER SUPPLIES**
- 3202 Turbo Cool 150 (25° - 40° cooler) . 129.
- 3200 Silencer 150 (84% noise reduction) 115.
- Pacific Data Products ... 1 year**
- 6779 25 Cartridges in One! (for LJ II, IIP, IID) 275.
- 7072 25 Cartridges in One! (for LJ III) ... 349.
- Memory upgrade for LaserJet IIP/III
- 7054 1 Meg ... 149. 7055 2 Meg ... 199.
- 7758 3 Meg ... 279. 7759 4 Meg ... 339.
- Memory upgrade for LaserJet II
- 6839 1 Meg ... 179. 6838 2 Meg ... 249.
- 7158 Pacific Page (PostScript Cartridge for LaserJet IIP/III) ... 379.
- 6834 Pacific Page with free 2 Meg Memory Board (for LaserJet II) ... 379.
- 7632 Outlines I. 209. 7631 Outlines II. 209.
- Practical Peripherals ... 5 years**
- 3101 1200 Baud Internal Modem ... 65.
- 3100 1200 Baud External Modem (mini) . 77.
- 3103 2400 Baud Internal Modem ... 135.



Intel ... 5 years
2346 Inboard 386/PC with Free Samna Arm—Gives you 80386 processing power, 1 Mb RAM, and Samna's powerful Windows-based word processor (regularly at \$129). 30 Day Money Back Guarantee. \$519.

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5285	2400 Baud Ext. MNP Modem (Lex. 5)	209.
4542	2400 Baud Internal Modem for PS/2 .	229.
	Reflection Technology ... 1 year	
7127	Private Eye (virtual display)	499.
	SAFE Power Systems ... 2 years	
7913	Safe 650W	459.
7914	Safe 800W	599.
4560	Safe 1200W	739.
	Targus ... lifetime	
4899	Nylon Laptop carrying case	55.
6037	Premier leather carrying case	199.
	TheComplete PC ... 2 years	
5140	TheComplete Page Scanner	549.
5828	TheComplete Communicator	449.
	Tripp Lite ... 2 years	
6199	Isobar 4-6 (4 outlets, 6 ft. cord) . . .	49.
6200	Isobar 6-6 (6 outlets, 6 ft. cord) . . .	59.
	Video 7 ... 7 years	
5883	1024i VGA (includes 512k)	219.
4931	VRAM VGA 512k	379.

2286	30 Meg Int. Hard Drive ST238R (w/controller and cables, 65 ms) .	\$269.
4554	40 Meg Int. HD ST251-1 (28 ms) . .	329.
	TEAC ... 1 year	
4951	720k Drive (specify XT or AT, 3 1/2") .	75.
4670	1.44 Meg Drive for PC/XT (3 1/2") . .	89.
4326	1.44 Meg Drive for AT	109.



Intel ... 5 years
7782 SatsFAXtion—Send and receive faxes from within most applications using the print command. Built-in 2400 bps MNP modem standard. Includes coupons for free PC Tools and Fax-It software. \$399.

MEMORY

6556	256k DRAMs (100 nanosecond) . . .	call
5510	1 Meg x 9 SIMMs (80 nanosecond) call	
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SAFE Power Systems ... 2 years
7913 Safe 650W—All new space-saving design provides easy storage of your battery backup. LED status lights, audible alarm, transient protection, and more. \$459.
(See SAFE Power listing for more models)



Canon ... 1 year
7894 BJ-10e BubbleJet Printer—Light weight, excellent print quality and a great price make this 4.6 lb. printer a winner. Choice of black or white. Optional sheet feeder \$349.



MECA ... NCP
4603 Andrew Tobias' Tax Cut—New power for handling your 1990 taxes. Import data from Quicken and/or TurboTax, read last year's Tax Cut data, and print your return—all with new versatility \$49.

DRIVES

	IONEGA ... 1 year	
5116	Bernoulli II Single 44 Meg Internal	995.
5113	44 Meg Cartridge Tripak (5 1/4") . .	249.
2500	PC2B Controller	229.
7551	Bernoulli II Transportable 44 Meg .	997.
	Mountain Computer ... 1 year	
2917	40-60 Meg Internal Tape Drive . . .	299.
5502	83-152M Ext. Tape Drive	799.
5190	DC2000 Pre-formatted Cartridges ea.	35.
	Pacific Rim ... 1 year	
5009	1.2 Meg External	209.
5010	1.2 Meg External (for PS/2's)	215.
6602	1.44 External (for PC/XT/AT)	239.
	Plus Development ... 2 years	
6425	Hardcard II 40 Meg (19 ms)	399.
6424	Hardcard II 80 Meg (19 ms)	699.
	Seagate ... 1 year	
2285	20 Meg Int. Hard Drive ST225 (w/controller and cables, 65 ms) . .	255.

DISKS

	Maxell ... lifetime	
2789	5 1/4" MD2-D 360k Disks (Qty. 10) . . .	12.
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	Sony ... lifetime	
3291	5 1/4" DS/DD 360k Disks (Qty. 10) . . .	10.
3292	5 1/4" DS/HD 1.2Mb Disks (Qty. 10) . .	19.
3297	3 1/2" DS/DD 720k Diskettes (Qty. 10) .	13.
3298	3 1/2" DS/HD 1.44Mb Diskettes (Qty. 10)	22.
6659	QD 2000 Tape Cartridge	19.

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- Call 603/446-7721 for information.

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PRINTERS

DOT MATRIX

Fact B3450

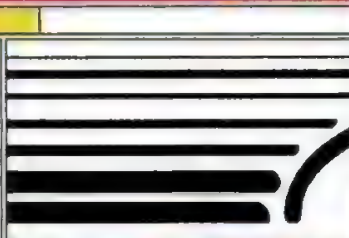
\$1,249

24-pin wide-carriage color-capable dot matrix printer; color ribbon, \$27

TEXT SPEED: 134 cps
GRAPHICS SPEED: 0.6 gppm
GRAPHICS TIME: 1 min. 39 sec.



Man's mind cannot
of events in their
but the desire to
is implanted in ma
Draft Bold Underli
Courier Bold Under



Fortis DM3215

\$699

9-pin wide-carriage color-capable dot matrix printer; color kit optional, \$99

TEXT SPEED: 125 cps
GRAPHICS SPEED: 0.5 gppm
GRAPHICS TIME: 1 min. 50 sec.



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is implanted in ma
Pica Bold Underli
NLQ Pica Bold Under



Fujitsu DL4600

\$1,650

24-pin wide-carriage color-capable dot matrix printer; color ribbon, \$45

TEXT SPEED: 169 cps
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 14 sec.



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Draft Bold Underli
Elite pitch Bold Under



Genicom 3840

\$2,595

18-pin wide-carriage monochrome dot matrix printer

TEXT SPEED: 241 cps
GRAPHICS SPEED: 1.9 gppm
GRAPHICS TIME: 0 min. 31 sec.



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but the desire to
is implanted in ma
10CPI Bold Underli
NLQ 10CPI Bold Under



Mannesmann Tally 130/9

\$699

9-pin narrow-carriage color-capable dot matrix printer; color kit optional, \$189

TEXT SPEED: 131 cps
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME: 0 min. 53 sec.



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of events in their
but the desire to
is implanted in ma
10CPI Bold Underli
NLQ 10CPI Bold Under



Mannesmann Tally 131/9

\$799

9-pin wide-carriage color-capable dot matrix printer; color kit optional, \$189

TEXT SPEED: 120 cps
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME: 0 min. 53 sec.



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10CPI Bold Underli
NLQ 10CPI Bold Under



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Call for additional information including a complete list of supported hardware.

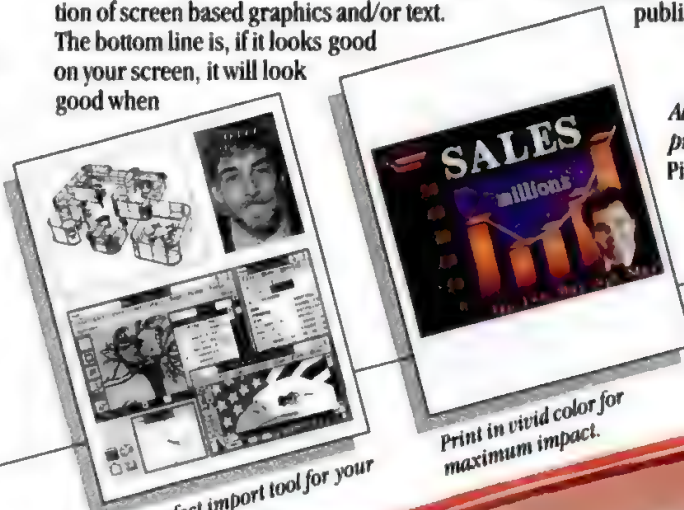
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CIRCLE 260 ON READER SERVICE CARD

PRINTERS

DOT MATRIX

Mankesmann Tany 130/24

\$399

24-pin narrow-carriage color-capable dot matrix printer; color kit optional, \$269



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of events in their
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is implanted in ma
10CPI **Bold Underli**
LQ 10CPI **Bold Unde**



TEXT SPEED 128 cps
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME 0 min. 54 sec.

Mankesmann Tany 131/24

\$399

24-pin wide-carriage color-capable dot matrix printer; color kit optional, \$269



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but the desire to
is implanted in ma
10CPI **Bold Underli**
NLQ 10CPI **Bold Unde**

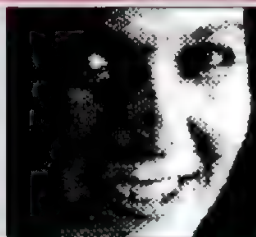


TEXT SPEED 127 cps
GRAPHICS SPEED: 1.1 gppm
GRAPHICS TIME 0 min. 55 sec.

NCR 6317-0101

\$500

9-pin narrow-carriage monochrome dot matrix printer



Man's mind cannot g
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but the desire to f
is implanted in man
12CPI **Bold Underline**
NLQ Courier **Bold L**



TEXT SPEED 162 cps
GRAPHICS SPEED: 1.7 gppm
GRAPHICS TIME 0 min. 35 sec.

NCR 6321-0201

\$1,050

9-pin wide-carriage monochrome dot matrix printer



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but the desire to find
is implanted in man's
12CPI **Bold Underline** Compre
LQ **Bold Underline** Compr



TEXT SPEED 134 cps
GRAPHICS SPEED: 1.2 gppm
GRAPHICS TIME 0 min. 52 sec.

NEC Pinwriter P6200

\$749

24-pin narrow-carriage color-capable dot matrix printer; optional color kit, \$119



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of events in their
but the desire to
is implanted in ma
Draft **Bold Underli**
ITC Souvenir **Bold**



TEXT SPEED 144 cps
GRAPHICS SPEED 0.3 gppm
GRAPHICS TIME 2 min. 59 sec.

NEC Pinwriter P6300

\$999

24-pin wide-carriage color-capable dot matrix printer; optional color kit, \$119



Man's mind cannot
of events in their
but the desire to
is implanted in ma
Draft **Bold Underli**
Courier **Bold Under**



TEXT SPEED 146 cps
GRAPHICS SPEED 0.3 gppm
GRAPHICS TIME 2 min. 59 sec.

ULTRA 96

V.32/V.42bis

X.32 (Dial X.25)

Since it was introduced four months ago, ULTRA 96 has become the fastest-selling Hayes modem ever.

Not only because the move to high-speed modems is in full swing, but because no other 9600 can deliver the features, performance, and networking capabilities of the fully loaded ULTRA 96.

ULTRA 96 provides up to 4-to-1 data compression, so it can save you money by letting you run computer equipment at its maximum speed.

In fact, you'll save so much on long-distance charges, your ULTRA 96 will pay for itself in just a few months. And its unique X.32 (Dial X.25) capability allows users to take advantage of the lower costs associated with the use of national and global packet-switched networks.

Of course, ULTRA™ works just as well on leased lines, satellite links, and other networks. It even automatically negotiates the best connection with other modems. Hayes or otherwise.

Plus, it uses the world standards for error-control and data compression, V.42 and V.42bis, and it can downshift to MNP® levels 2 through 5.

What's more, ULTRA 96 is compatible with the most popular high-speed modem on the market. The Hayes V-series® Smartmodem 9600.™

If you want to move up to the higher speeds and performance of ULTRA 96, you better order it now. Because it's going fast... even with our factory running 24 hours a day.

For more information about Hayes ULTRA 96, call 1-800-635-1225.

Hayes. Our technology has the computer world talking. More than ever.
CIRCLE 136 ON READER SERVICE CARD

At 38,400 bps, it's not only the fastest V.32 modem on the street, it's the fastest off the showroom floor.



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Outstanding Disk Performance. When we say "more power than ever", we mean it. We just added Maxtor IDE hard drives with the fastest access times around. With the 486-25, 386-33 and 386-25 (cache) systems you'll get a powerful 200MB's of storage and an unbelievable 15MS access time. With the 386-25 (no cache) and the 386-SX systems you'll get 80MB capacity and a super fast 19MS access time.

The Most Spectacular Video. We selected the finest monitor around, the non-interlaced SONY Trinitron Super VGA and coupled it with a 16 Bit VGA card with 512K RAM (upgrade to 1MB available). With this combination the image you see will be as sharp and clear as a color print. You won't believe your eyes!!!

All The Memory You'll Need. 4MB RAM (expandable to 16MB) and a 64K static RAM cache for the 486-25, 386-33 and 386-25 systems. Or you can choose between a 386-25 with 4MB RAM and a 386-SX with 2MB RAM (both also expand up to 16MB RAM). Pick the system configuration that fits your needs.

Microsoft Mouse and Windows: a Winning Team. All Ultra-Power systems now include the easy to use Microsoft Windows 3.0 graphical environment and the Mouse that outperforms all the others. PLUS your choice of either MS-DOS 3.3 or 4.01.

Two Teac Floppy Drives. Two high density floppy drives: both a 5.25" and a 3.5". The Teac name is known around the world for quality and dependability.

The Best Keyboard. The Ultra-Click 101 key keyboard, recognized for its superior touch and exceptional on-the-job reliability.

Did We Leave Anything Out? Every system includes a 30 day money back guarantee, one year warranty and toll free technical support. If you don't see the system you want, call for custom configuration pricing. On-Site and Extended Warranties are also available.



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In Missouri Call 314-991-1988



System shown
with optional
vertical case.

WARNING!!! Compare Ultra-Power systems to our competitors! Ultra-Power systems feature non-interlaced SONY monitors. The difference between interlacing and non-interlacing is like night and day. Non-interlaced monitors provide a crisp, high resolution image. Interlaced monitors cheat to achieve 1024x768 resolution by refreshing the horizontal lines at half the rate of non-interlaced monitors, causing the image you see to flicker. If you're looking for a high resolution solution don't waste your money on inferior products.

ULTRA-MAX 486-25

- 64K 25NS Static RAM Cache
 - 4MB RAM
 - 200MB 15MS IDE Hard Drive
 - 1.2MB 5.25" Floppy Drive
 - 1.44MB 3.5" Floppy Drive
 - 16 Bit VGA Card w/ 512K RAM
- Add \$150 for vertical CPU case.

\$5495

- 14" SONY Trinitron 1024x768 Super VGA Monitor
- Microsoft Mouse
- Microsoft Windows 3.0
- MS-DOS 4.01 or 3.3
- Ultra-Click 101 Key Keyboard
- 1 Parallel & 2 Serial Ports

ULTRA-MAX 386-33

- 64K 25NS Static RAM Cache
 - 4MB RAM
 - 200MB 15MS IDE Hard Drive
 - 1.2MB 5.25" Floppy Drive
 - 1.44MB 3.5" Floppy Drive
 - 16 Bit VGA Card w/ 512K RAM
- Add \$150 for vertical CPU case.

\$4195

- 14" SONY Trinitron 1024x768 Super VGA Monitor
- Microsoft Mouse
- Microsoft Windows 3.0
- MS-DOS 4.01 or 3.3
- Ultra-Click 101 Key Keyboard
- 1 Parallel & 2 Serial Ports

ULTRA 386-25

- 64K 25NS Static RAM Cache
 - 4MB RAM
 - 200MB 15MS IDE Hard Drive
 - 1.2MB 5.25" Floppy Drive
 - 1.44MB 3.5" Floppy Drive
 - 16 Bit VGA Card w/ 512K RAM
- Add \$150 for vertical CPU case.

\$3795

- 14" SONY Trinitron 1024x768 Super VGA Monitor
- Microsoft Mouse
- Microsoft Windows 3.0
- MS-DOS 4.01 or 3.3
- Ultra-Click 101 Key Keyboard
- 1 Parallel & 2 Serial Ports

ULTRA 386-25

- 4MB RAM
 - 80MB 19MS IDE Hard Drive
 - 1.2MB 5.25" Floppy Drive
 - 1.44MB 3.5" Floppy Drive
 - 16 Bit VGA Card w/ 512K RAM
 - 14" SONY Trinitron 1024x768 Super VGA Monitor
- Add \$150 for vertical CPU case.

\$2895

- Page Mode Memory & Shadow Support
- Microsoft Mouse
- Microsoft Windows 3.0
- MS-DOS 4.01 or 3.3
- Ultra-Click 101 Key Keyboard
- 1 Parallel & 2 Serial Ports

ULTRA 386-SX

- 2MB RAM
 - 80MB 19MS IDE Hard Drive
 - 1.2MB 5.25" Floppy Drive
 - 1.44MB 3.5" Floppy Drive
 - 16 Bit VGA Card w/ 512K RAM
 - 14" SONY Trinitron 1024x768 Super VGA Monitor
- Add \$150 for vertical CPU case.

\$2395

- Page Mode Memory & Shadow Support
- Microsoft Mouse
- Microsoft Windows 3.0
- MS-DOS 4.01 or 3.3
- Ultra-Click 101 Key Keyboard
- 1 Parallel & 2 Serial Ports

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CIRCLE 177 ON READER SERVICE CARD

ULTRA-COMP

PRINTERS

DOT MATRIX

Okidata Microline 380

\$449

24-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED: 89 cps
GRAPHICS SPEED: 0.7 gppm
GRAPHICS TIME: 1 min. 30 sec.



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Okidata Microline 390 Plus

\$649

24-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED: 140 cps
GRAPHICS SPEED: 0.9 gppm
GRAPHICS TIME: 1 min. 3 sec.



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Prestige Bold Unde



Okidata Microline 391 Plus

\$949

24-pin wide-carriage monochrome dot matrix printer

TEXT SPEED: 140 cps
GRAPHICS SPEED: 0.9 gppm
GRAPHICS TIME: 1 min. 4 sec.



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Okidata Microline 393 Plus

\$1,499

24-pin wide-carriage monochrome dot matrix printer; color version available for additional \$100; accepts up to 100-lb. paper; rated at 520 cps

TEXT SPEED: 167 cps
GRAPHICS SPEED: 1.4 gppm
GRAPHICS TIME: 0 min. 42 sec.



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Olivetti DM105S

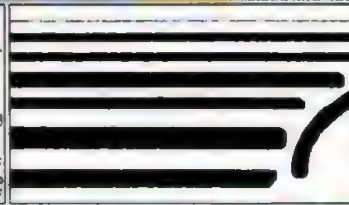
\$399

9-pin narrow-carriage color dot matrix printer

TEXT SPEED: 67 cps
GRAPHICS SPEED: 0.3 gppm
GRAPHICS TIME: 3 min. 5 sec.



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NLQ Pica Bold Unde



Olivetti DM309E

\$759

9-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED: 144 cps
GRAPHICS SPEED: 0.9 gppm
GRAPHICS TIME: 1 min. 7 sec.



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NLQ 10CPI Bold Unde



INTRODUCING ALL THE WRITE STUFF FOR SMALL BUSINESS TYPES



**NX-2420
RAINBOW**



**NX-1020
RAINBOW**



**NX-1001
MULTI-FONT**



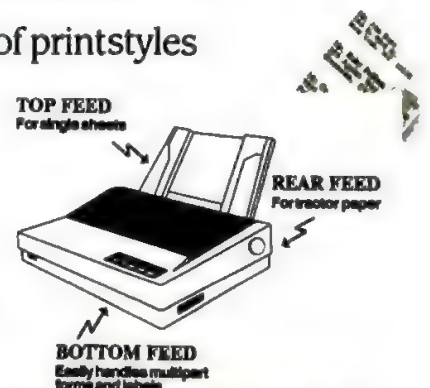
**NX-2420
MULTI-FONT**

For a while there, it was beginning to look like there would never be a dot matrix printer versatile enough to be a real jack-of-all-trades. But no more. Now, for the first time ever, there's a new series of printers designed to bring you big-business performance at a small-business price.

Star's new NX Series printers have all the write stuff you need to get the job done and then some. Let's start with multiple fonts. Each of the four NX Series printers comes equipped with an incredible variety of fonts, sizes and enhancements,

which, when combined, put thousands of printstyles at your fingertips. And all offer high resolution graphics for more professional-looking presentations.

Advanced paper handling features
(which are optional on most printers)



DESKTOP NEWS

VOLUME 2 *Microcomputing... Micrographics* No. 2



Multiple fonts

Advanced
paper handling

are standard with Star. The switchable push/pull tractor makes changing paper paths a snap — a feature that's especially handy when you're printing a lot of hard-to-manage forms. Plus, convenient paper parking lets you feed single sheets through at the touch of a button — without removing or wasting continuous-feed paper.



User-friendly control panel

NX printer control panels are designed for the ultimate in user-friendliness. You can easily select up to 14 of the most commonly used functions. And an Electronic Dip Switch Mode lets you customize the control panel with up to 15 of your own power-on settings.

Star's NX printers are Epson and IBM* compatible for use with most off-the-shelf software packages. Their standard parallel centronics interface with optional serial-to-parallel



Compatibility

converter makes them simple to use with most personal computers. All are capable of high-speed, bi-directional printing at extremely low noise levels. And the two *RAINBOW* models — the NX-1020 and NX-2420 — even offer printing in seven vibrant colors.



Color printing



Low noise level

Star has one of the largest selections of printers available for

small businesses. So make sure you take a look at our

2-YEAR LIMITED WARRANTY

new line of NX printers. They're engineered to give you the price-performance of a lifetime. To find out where you can get all the write stuff from Star, call 1-800-447-4700 now.

star
THE COMPUTER PRINTER

CIRCLE 173 ON READER SERVICE CARD

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PRINTERS DOT MATRIX

Olivetti DM600S

\$1,895

24-pin wide-carriage monochrome dot matrix printer

TEXT SPEED: 172 cps
GRAPHICS SPEED: 1.0 gppm
GRAPHICS TIME: 0 min. 58 sec.



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Panasonic KX-P1624

\$700

24-pin wide-carriage monochrome dot matrix printer

TEXT SPEED: 98 cps
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 14 sec.



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Panasonic KX-P1695

\$700

9-pin wide-carriage monochrome dot matrix printer

TEXT SPEED: 140 cps
GRAPHICS SPEED: 1.3 gppm
GRAPHICS TIME: 0 min. 47 sec.



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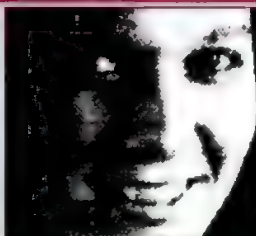


Seikosha SL-90

\$499

24-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED: 83 cps
GRAPHICS SPEED: 1.5 gppm
GRAPHICS TIME: 0 min. 39 sec.



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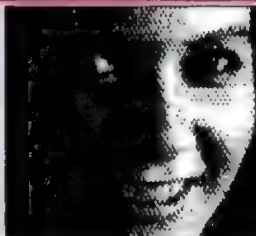


Seikosha SP-2000

\$329

9-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED: 88 cps
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 12 sec.



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Star Micronics NX-1500

\$499

9-pin wide-carriage monochrome dot matrix printer

TEXT SPEED: 91 cps
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 13 sec.



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What To Do When Your Disk Drive's Getting Full.

EXPANZ![™]
DISK EXPANDER CARD

Turn VOL

Introducing EXPANZ!™ The revolutionary disk expander card that cranks up the volume on disk storage capacity.

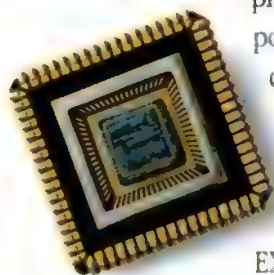
Until now, you've had only two ways to increase storage on a full disk drive. Delete files. Or buy an expensive hard drive. Now there's an easier way, thanks to the EXPANZ! Card from InfoChip™ Systems.

With the new EXPANZ! data compression card, you can boost hard disk capacity up to three times. Even more with floppy disks. On all IBM® PC/XT/AT (including 386 and 486) and 100% compatible computers.

Data Compresses Automatically

The EXPANZ! card is easy to use. It plugs into any open slot in your system and intercepts calls to and from the disk controllers. Just choose the drives or partitions to be compressed, and EXPANZ! does the rest. Transparently. Because it operates in real time, everything works automatically. Data compresses and decompresses instantly. There are no confusing DOS commands to learn. Or complicated software to run.

In addition, EXPANZ! effectively eliminates the 32MB DOS barrier by tripling the size of the original partition.



Files are 100% Safe

What's more, EXPANZ! gives you 100% data integrity. Through a unique technology called noiseless/lossless compression, your decompressed information is exactly the same as your original. So files are 100% accurate and dependable. Whether they're word processing files, spreadsheets, databases, graphics or CAD.

EXPANZ! also gives you a utility that lists a directory comparing uncompressed and compressed file sizes along with each file's compression ratio.

To safeguard your work, we've included another utility that allows you to bypass the card. So you always have access to your compressed data.

Compression Options for Floppies

With EXPANZ! you can choose to compress or decompress data onto floppy drives. EXPANZ! is programmed to transfer data onto floppy drives uncompressed, so you can conveniently transport data to other PCs. If you'd rather compress data onto your floppy, just use a simple software command.

A Powerful Engine

The exceptional power of the EXPANZ! card comes from InfoChip's revolutionary IC-105 data compression co-processor. This proprietary high-speed chip incorporates noiseless/lossless technology into an adaptive, fast converging algorithm.



Up The VOLUME!



As the "engine" in the EXPANZ! Disk Expander Card, the IC-105 allows you to boost storage capacity in all types of random access storage devices. Hard disks, floppies, optical disks and RAM disks, to name a few.

In fact, there's no limit to the number of mass storage devices EXPANZ! can support on your system.

Performance You Can Count On

With EXPANZ! both compression and decompression happen in real time, so overall system performance will remain virtually unchanged. Your actual compression ratios and performance will vary based upon the type of data compressed and the requirements of the software application in use.

Databases, Lotus® 1-2-3®, graphic image files, AutoCAD®, desktop publishing and word processing data files experience the most compression. Executable files and previously compressed data benefit the least. Disk capacity will vary as files are added, since compression ratios vary based on the type of data you are compressing.

Half-Card Solution

The EXPANZ! Disk Expander Card is a snap to install. It's a half-card designed to work in all IBM PC/XT/AT or 100% compatible computers running MS or PC DOS 3.x*. It plugs into any 8- or 16-bit

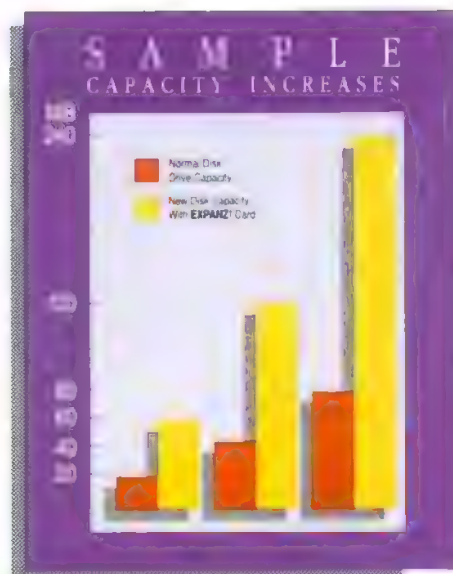
expansion slot in minutes. EXPANZ! works with your existing controller. No cables, brackets or extra power supplies are required.

Service & Support

EXPANZ! is also supported with easy-to-understand documentation, toll-free technical support and a one year limited warranty.

So if your disk drive's getting full, don't delete files or buy a new drive. Get the EXPANZ! Disk Expander Card from InfoChip Systems. Contact your dealer or distributor or call (800) 447-0200 or (408) 727-0514 for more information.

And turn up the volume today.


*Except for OS/2 and DOS 3.31 and similar proprietary revisions.

SAMPLE COMPRESSION RATIOS

SPECIFICATIONS

File Type

CCITT Group III Documents	4-12:1
Database	2-10:1
Image Files	1.5-15:1
CAD/CAM Files	2-12:1
Word Processing and Spreadsheet Files	2-3:1
Executable Code	1-2:1

These figures are to be used as guidelines, and in no way represent guaranteed compression ratios. Your actual performance may vary depending upon the type of data stored.

Compatibility

- Designed to function with the IBM PC/XT/AT (8086/88, 286, 386, 486) and 100% compatible DOS-based systems
- Supports MS or PC DOS 3.x (DOS 4.x will be supported by early 1991)

Physical Characteristics

- Fits ISA 8- or 16-bit expansion slot
- Height: 4.2" Length: 5.5" Weight: 6 oz.
- Connector: 8-bit bus for IBM PC/XT/AT (8086/88, 286, 386, 486) compatibility

Electrical

- Voltage: +5V ($\pm 5\%$), 1.60 A, calculated maximum
- FCC Class B

Environmental Limitations

- Ambient Temperature:
Storage: -40 to +75 C
Operating: 0 to +70 C (Inside host system)
- Ambient Relative Humidity:
Storage: 10% to 95% RH, noncondensing
Operating: 10% to 95% RH, noncondensing

Warranty

- The EXPANZI Card carries a one year manufacturer's warranty
- Toll-free technical support is provided for the life of the warranty

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PRINTERS

DOT MATRIX

Star Micronics NX-2410 Multi Font

\$399

24-pin narrow-carriage monochrome dot matrix printer

TEXT SPEED: 91 cps
GRAPHICS SPEED: 0.9 cps
GRAPHICS TIME: 1 min. 4 sec.



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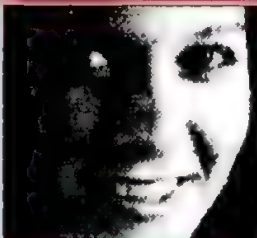


Star Micronics NX-2415 Multi Font

\$659

24-pin wide-carriage monochrome dot matrix printer

TEXT SPEED: 100 cps
GRAPHICS SPEED: 0.9 gppm
GRAPHICS TIME: 1 min. 10 sec.



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Star Micronics XR-1000 Multi Font

\$499

9-pin narrow-carriage color-capable dot matrix printer; color kit optional, \$50

TEXT SPEED: 124 cps
GRAPHICS SPEED: 0.3 gppm
GRAPHICS TIME: 2 min. 55 sec.



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Tandy DMP 240

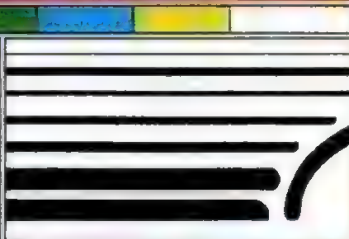
\$550

24-pin narrow-carriage color-capable dot matrix printer; color ribbon optional, \$30

TEXT SPEED: 98 cps
GRAPHICS SPEED: 0.6 gppm
GRAPHICS TIME: 1 min. 37 sec.



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Tandy DMP 2130

\$1,100

28-pin wide-carriage monochrome dot matrix printer

TEXT SPEED: 108 cps
GRAPHICS SPEED: 1.5 gppm
GRAPHICS TIME: 0 min. 41 sec.



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Texas Instruments 8930

\$2,545

18-pin wide-carriage color-capable dot matrix printer; color ribbon optional, \$30

TEXT SPEED: 174 cps
GRAPHICS SPEED: 0.8 gppm
GRAPHICS TIME: 1 min. 16 sec.



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AEG Olympia NP 80-24E

by Mario R. Baldasserini

Last year, when we reviewed two 24-pin machines by AEG Olympia Corp.—the \$599 NP 80-24 and the \$799 NP 136-24—we awarded one of them—the wide-carriage NP 136-24—an Editor's Choice (see Printer Blockbuster Issue, November 14, 1989). Both machines generated the same high-quality output and, apart from their different carriage widths, offered the same generous feature set. This year, AEG Olympia submitted a new version of its narrow-carriage NP 80-24. Dubbed the NP 80-24E, this entry-level model offers the excellent print features and output quality of its forerunner at a more aggressive price: \$499.

The NP 80-24E differs from its predecessor in several respects. First, to help trim the price to this level, AEG Olympia dispensed with the 16-character LCD display on the front panel, replacing it with five additional LED indicators. You still get the same configuration menus and features, accessible through the six front-

FONTS & FEATURES				
AEG Olympia NP 80-24E				
Epson LQ				
	Bold	Italic	Sub/Supr	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

panel buttons, but you must depend on the indicators rather than an LCD display to guide you through the menus. Fortunately, the excellent design of the panel and menus makes configuration a simple matter even without the display panel.

To cut the price even further, however, the company no longer includes the standard-equipment serial connector, making it a \$79 option instead.

You'll also find another bit of interesting news in the short list of changes: AEG Olympia increased the maximum graphics resolution to 360 by 360 dpi, up from the already impressive 360 by 180 dpi of last year's models.

As with the previous model, the NP 80-24E occupies a footprint of 16.5 by 12 inches (WD), requiring little desktop space. The tractor-feed mechanism is of the push type, and the paper-parking feature, which allows use of the single-sheet

PRINTERS DOT MATRIX

feed without removing the continuous paper, is activated by the pull of a single lever. The machine is rated to accept a maximum paper thickness of 0.018 inches, and we were able to feed through thick card stock without a glitch. Optional paper-handling attachments include a \$219 single-bin cut-sheet feeder that holds 100 pages and a \$378 dual-bin sheet feeder that holds 200 pages.

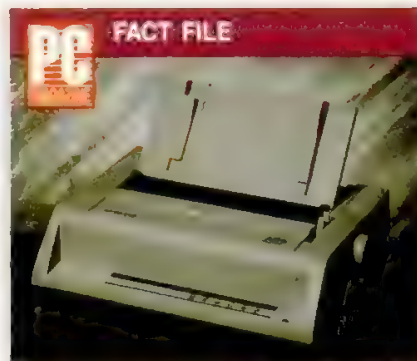
The NP 80-24E's power-on configuration, activated by depressing the menu button during power-up, lets you choose between its Epson LQ-2500 and IBM Proprinter XL24 emulations. Other configuration choices include character set, baud rate, download buffer, and alignment, among others.

Pressing the menu button while the printer is already on leads you to a different menu system that lets you select font, pitch, left and right margins, page length, and print direction (bidirectional, unidirectional, or fast bidirectional). In an especially nice touch, the printer also allows you to set up two separate menus, each with its own default values, for each parameter.

The NP 80-24E offers five typefaces in addition to draft—Courier, OCRB-Extended, Prestige, Gothic, and Optimo—and each type style is available in 12 different pitch sizes. Of these, most change only character width or spacing, but the choices still make for a great deal of flexibility, especially when combined with the printer's full collection of print and character enhancements. AEG sells an optional font cartridge with three additional fonts—Presentor, Square, and Script—for \$79. The NP 80-24E comes standard with a generous 24K print buffer, expandable to 56K with the addition of a \$40 upgrade.

As with last year's models, the print quality of the NP 80-24E rates no less than outstanding. Each character appears well-shaped and shows little or no trace of the dots that form it. Even draft-mode type has a truly letter-quality look. This printer also excels at graphics. It reproduced our test image with admirable results, retaining even subtle shadings.

When it comes to speed, the 80-24E doesn't break any records, but it does hold its own against many of its more-expensive 24-pin competitors. With 10-cpi text under the default Epson emulation, it clocked in at 104.8 cps in draft mode and 49.7 cps in letter quality. Results were



AEG Olympia NP 80-24E

AEG Olympia Corp., 3140 Route 22, Somerville, NJ 08876; (800) 999-6872, (201) 231-8300.

List Price: \$499; upgrade to 56K, \$40; font cartridge, \$79; single-bin cut-sheet feeder, \$219; dual-bin cut-sheet feeder, \$378; serial interface, \$79.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 10 x 17.5 x 13.5 in.

Weight: 17.6 lbs.

Emulations: Epson LQ; IBM Proprinter.

In Short: The 24-pin AEG Olympia NP 80-24E combines ease of use, exceptional text and graphics output, and a multitude of features in a bargain-priced package.

CIRCLE #13 ON READER SERVICE CARD

nearly identical with the Proprinter emulation enabled: 104.8 and 50.4. AEG rates the machine at 200 cps for 12-cpi draft and 67 cps for 12-cpi letter quality.

The printer also turned in fairly consistent results on our graphics tests no matter what emulation was used, completing our samples at a rate of 1.0 gppm. This isn't bad for a 24-pin machine, especially when the output looks this good.

With its abundance of features, respectable speed, 360- by 360-dpi graphics resolution, and excellent print quality, the AEG Olympia NP 80-24E truly ranks among the best values going in 24-pin dot matrix printers, especially at its \$499 price. Don't be too quick to overlook this machine, even if you wouldn't mind spending more money.

AEG Olympia NP 80SE and NP 136SE

by Alfred Poor

These two printers from AEG Olympia carry midrange prices (\$499 for the NP 80SE and \$699 for the NP 136SE); both have good speed and some fancy features. Their greatest handicap, however, is their 9-pin print technology, though they do their best to overcome it.

The NP 80SE and NP 136SE share



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EDITOR'S CHOICE

- Citizen GSX-140 (24-pin)
- Citizen 200GX (9-pin)
- Epson DFX-8000 (9-pin high duty cycle)
- Epson LQ-850 and Epson LQ-1050 (24-pin)
- NEC Pinwriter P6200 and NEC Pinwriter P6300 (24-pin)

Of the 68 dot matrix printers we reviewed, you should be satisfied with the abilities, speed, and print quality of the majority. Dot matrix printers are rugged, inherently reliable, affordable, and less expensive to operate than laser printers.

None of these printers matches the output quality of a laser, but the better 24-pin printers come closer every year. In some cases, a vendor's narrow-carriage printer may be built for the lowest price; the wide-carriage version may be slightly faster and more rugged. Don't get hung up on small differences in printer speed or price; you'll find it's worth a few dollars to get a well-thought-out control panel or intelligent paper handling. As the cost difference narrows between 24- and 9-pin printers, you'll likely find yourself drawn to the 24-pin variety unless you're dedicating the printer to multipart forms or other data processing needs.

The 24-pin Epson LQ-850 and wide-carriage LQ-1050 received Editor's Choice in 1987. The current versions—\$749 and \$1,099, respectively—are substantially faster and easier to use. The two Epsoms were the fastest of all 24-pin printers on PC Labs' graphics speed test and returned above-average text speeds of about 63 characters per second in LQ mode and 130 cps draft. (All the speeds cited here are as tested by PC Labs.) If you want color, you'll need to specify the Epson LQ-860, rather than add a color module, as many other printers require. At \$949, the LQ-860 is a good printer but a bit pricey. You probably won't experience failures with any Epson printer; in our recent service and reliability issue (September 25,

1990), Epson finished second overall to Hewlett-Packard.

NEC builds rugged printers, and two of the best are the 24-pin Pinwriter P6200 and P6300, at \$799 and \$999. Setup is quick and easy, the front panel is thoughtfully designed, paper handling is superb, the print buffer is a generous 80K, and there's a bottom-feed slot for bulky forms and labels. Actual print speed is very near the top of all 24-pin printers, at about 145 cps in draft mode, 69 cps in letter quality. The narrow-carriage P6200 actually accepts 11-inch paper. NEC provides options that include color, single- and double-bin sheet feeders, and slip-in font cartridges. PC Labs found some minor bugs in the current NEC-written *Microsoft Windows 3.0* driver, but that shouldn't be hard to fix.

For affordable 24-pin printing, the best choice is the Citizen GSX-140, at \$499 list. For a street price just under \$300, you'll get 94 cps in draft mode and 44 cps in LQ. Text quality is first rate, and paper-handling options are affordable. The \$59 color upgrade kit produces excellent results. Tandy sells the same printer—the Tandy DMP 240—but at a higher price (\$550) and with a shorter warranty.

Several other 24-pin printers merit honorable mention because of superior price/performance, features, and print quality. If you're looking for rock-bottom prices, possibly as low as \$250 on the street, consider the \$399 Star Micronics NX-2410 Multi Font. This light, compact, narrow-carriage printer returns 91 cps in draft mode, 41 cps in LQ. The Okidata Microline 380, \$449 list and about \$300 street price, falls near the bottom on speed (89 cps for draft and 45 cps in LQ), but everything else is above average: print quality, number of fonts, and front panel controls. The ALPS Allegro 500 and wide-carriage 500XT, at \$499 and \$799, provide a plethora of built-in fonts and MacroMind, a handy way to switch between fonts and settings.

The narrow-carriage Allegro 500 prints 113 cps draft and 51 cps in LQ.

Brother International's wide-carriage M-1924L, for \$949, provides superior graphics, multiple built-in fonts, and a \$78 color upgrade. The color-ready C-Tech C-610C Plus, \$859, runs faster (112 cps draft, 48 cps LQ) and now accepts font cartridges—two improvements on the similar C. Itoh C-610 that received Editors' Choice last year. The straight-through, back-to-front paper path reduces paper jams, but paper loading is a bit awkward.

Nine-pin printers fall into two categories: affordable personal printers with list and selling prices well under \$500, and heavy-duty workhorses well over \$1,000.

Among affordable 9-pin printers, our choice is the Citizen 200GX, \$299 list, a light, compact unit with good draft printing speed (108 cps) and passable LQ speed (37 cps). Documentation is first-rate and color is a \$59 add-on. Two low-cost 9-pin printers merit honorable mentions. The Facit B1200 lists for \$269 and should sell for about \$200. Speed is 74 cps in draft and 23 cps in LQ. The wide-carriage Panasonic KX-P1695 is \$700 list and sells for about \$350 on the street. It prints at 140 cps draft and 55 cps in LQ. *PC Magazine's* staff is evenly split over Panasonic's front-panel options matrix; some say it's the easiest panel to use of any printer once you get the hang of it, while others find it insufferably complex—an example of why you should try any printer before you buy.

As PCs take on the data processing services performed by minicomputers, you need rugged line-printer equivalents. Epson's 9-pin dot matrix DFX-8000 fills the bill nicely: 64 pounds, a \$3,699 price tag, an 11,000 pages-per-month duty cycle, and 324 cps in draft mode. It's also relatively quiet and attractively designed. If you're willing to trade speed to save a few dollars, consider a pair of wide-carriage 18-pin printers that function as dual-bank 9-pin devices: the Genicom 3840, \$2,595 and 241 cps in draft mode; and the CIE CI-5000, \$1,995 and 250 cps in draft.

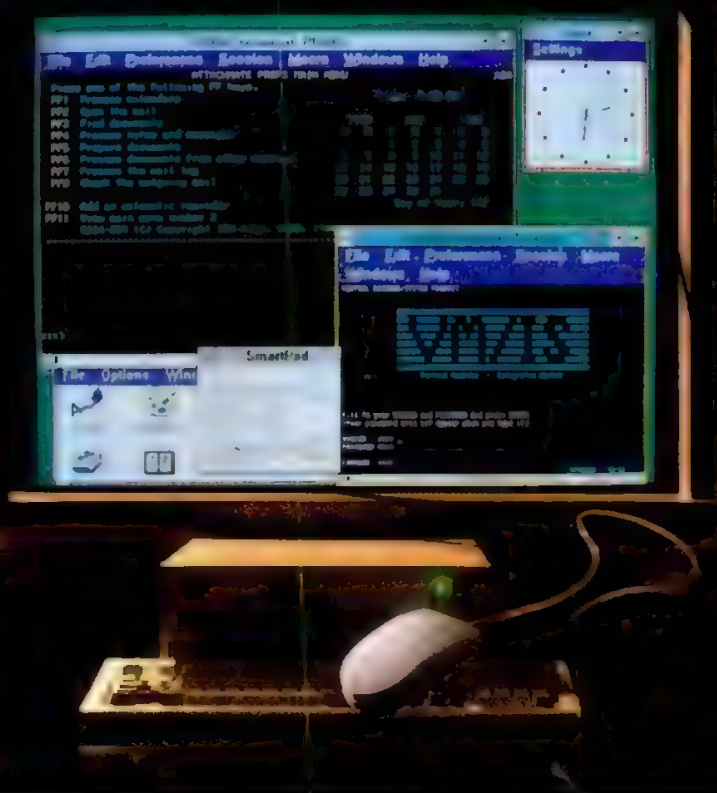
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many of the bells and whistles found on the 24-pin AEG Olympia printers reviewed in last year's Printer Project. The front panel offers membrane keys and a 16-character LCD message window with prompts for configuration and status messages spelled out in plain English. The operation of the setup menu is a little tricky but works well once you get the hang of it.

These two printers also have some features that are typical of printers in its range: intelligent paper handling with a paper-park function, optional fonts in a ROM cartridge, and optional tractor and cut-sheet bin feeders. They offer both Epson and IBM Proprietary emulations. When it comes to buying ribbons, you're likely to appreciate AEG Olympia's decision not to reinvent the wheel: The ribbons are "plug-compatible" with the Epson FX-850 and FX-1050 ribbons.

Both printers perform well. In the speed tests, they scored in the top half of the field in both the graphics and the text timings. The results show that the speed drops by about two-thirds from draft to NLQ, which is not unusual for 9-pin printers; in fact, it's even better than what the vendor's specifications indicate. Bidirectional printing for both text and graphics print modes help boost the printers' performance.

Considering that it was produced by a 9-pin printhead, the output is good. Draft text shows the typical grainy quality that

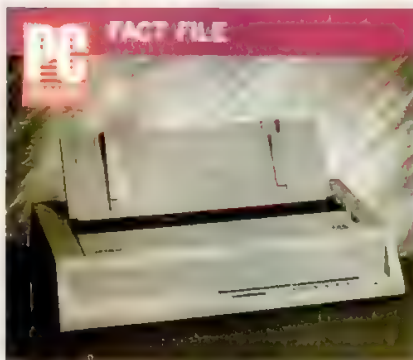
AEG Olympia NP 136SE				
Epson FX				
	Bold	Italic	Sub/Sup	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

screams "computer printout," but the NLQ modes are quite good. You are not likely to mistake them for laser printer output, or even 24-pin printing, but the results are better than those of many other 9-pin machines. Graphics tended to be a bit dark, but the lines were crisp and clear.

There are a few shortcomings, such as the documentation. The printers come with two slim manuals that cover the territory, but lack of an index in either makes it more difficult to find needed information, though each book does include a detailed table of contents.

A more significant problem is the sound. All the good metaphors for the awful sounds made by dot matrix printers

PRINTERS DOT MATRIX



AEG Olympia NP 80SE
AEG Olympia NP 136SE
 AEG Olympia Corp., 3140 Route 22, Somerville, NJ 08876; (800) 999-6872, (201) 231-8300.
List Price: \$499 (NP 80SE); \$699 (NP 136SE); five-font module, \$79; single-bin sheet feeder (NP 80SE), \$219; dual-bin sheet feeder (NP 80SE), \$378; single-bin sheet feeder (NP 136SE), \$299; dual-bin sheet feeder (NP 136SE), \$528.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 5.8 x 17.8 x 15.8 in. (NP 80SE); 5.8 x 24.4 x 15.8 in. (NP 136SE).
Weight: 17.6 lbs. (NP 80SE); 22.0 lbs. (NP 136SE).
Emulations: Epson EX, IBM Proprietary.
In Short: These 9-pin models generate quality output and boast a few distinguishing features, but are handicapped by their noisy operation and unaggressive pricing.

CIRCLE 614 ON READER SERVICE CARD

have already been taken—pick your favorite and it applies here. Most printers in the current crop have improved sound-proofing built into their cases, but not these two from AEG Olympia. If you have to be in the same room while they are operating, plan to invest in either a noise-reduction box for the printer or in a very loud stereo system for yourself; better yet, get both.

Even without the extra money for the box or stereo, however, the NP 80SE and NP 136SE cost a lot for 9-pin technology, which makes it difficult to place them among the competition. If you don't need the quality, other 9-pins are available for less. And if you do want quality, there are 24-pin alternatives that cost about the same or only slightly more and offer better output. The LCD panel and good speed are nice, but not enough to make these printers attractive values.

ALPS ASP1600

by Meredith Miranda Gadsby

Even if you can't spend a lot of money on a printer, you still have a lot of choices. Among them is ALPS Electric's

ASP1600, a \$299 dot matrix printer that comes with a serif type style in several fixed pitches. It offers average, if not spectacular, performance and produces text of admirable quality for a 9-pin machine.

Weighing 9 pounds and measuring 4.3 by 15.8 by 10.5 inches (HWD), the lightweight ALPS ASP1600 won't take up much room on your desk. Two metal stands will raise the narrow-carriage printer approximately 2 to 4 inches off your desktop, so you can place fanfold paper under the unit to conserve space. Paper travels through the ASP1600 in a front-feed flat path. The printer does not offer paper parking, and no optional sheet feeders are available.

The ASP1600 can emulate two popular printers, the Epson FX and the IBM Graphics Printer. In our text speed tests, the printer operated at 59 cps in draft mode and at 19.9 cps in letter-quality mode under the default Epson FX emulation. These speeds don't make the ASP1600 a front-runner, but they are acceptable for the price.

The printer's letter-quality output shows little evidence of the dots of which it is composed. Letter-forms in draft text are considerably looser, but that should be no surprise. As for graphics, quality and speed vary with the emulation. When printed under the ASP1600's Epson FX emulation, our test images showed traces

ALPS ASP1600				
Epson FX				
	Bold	Italic	Sub/Sup	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

of horizontal white lines, and their shadows were rendered less than subtly. We saw an appreciable improvement when we tested the printer under IBM Graphics Printer emulation. Test images printed in this mode were sharp, and their details were preserved.

The ASP1600's standard serif type style can be printed in several pitches, including 10 cpi, 12 cpi, proportional, and condensed. You can enhance these with boldfacing, underlining, and italics, and you can print super- and subscripts in each font. If those don't do the trick, you can download additional fonts to the printer's 8K buffer.

The ASP1600's control panel uses

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MANNESMANN TALLY 645: Line Printing at Laser Speed

by Ed Perratore

You've probably seen one if you've had to retrieve accounting reports or reams of multipart forms from your company's data center. That's the home of high-speed line printers like Mannesmann Tally's \$5,999 645, a rugged 77-pound unit that works with mainframes, minicomputers, and networked or standalone PCs. It cranks out text pages at a measured rate of 450.8 lines per minute in draft mode, which is the equivalent of 10.9 ppm.

Designed for departmental or company-wide use, the wide-carriage 645 is built for speed rather than for producing fancy type enhancements. In addition to yielding faster text speeds on our tests than many laser printers, it also printed graphics quickly, churning them out at a rate of 3.1 gppm under IBM Proprinter emulation and 2.0 gppm under Epson FX emulation.

Besides offering IBM Proprinter and Epson FX emulations, the 645 can emulate Mannesmann Tally's 660 and 690 line printers and Printronix's P600. The printer cannot handle font cartridges, but it does offer crisp NLQ Courier and Gothic fonts (with italics in each) in addition to its draft Data Processing font. It will also store downloadable fonts in its 4K memory.

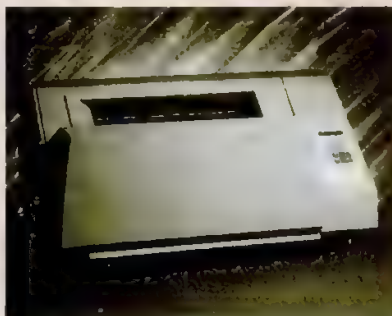
For the most part, the 645's emulations are precise. But because line printer design differs from that of serial or character-based printers, the 645 produced a few anomalies when we tested it in Proprinter mode. Codes for bold, double-strike, emphasized, and enhanced printing produced bold, plain, and simple type. Super- and subscripts assumed raised and lowered positions, but they remained the same size as the rest of the text, making for some crowded lines. Proportional spacing is only accessible via the control panel, not through escape codes.

You choose emulations and interface type, set margins and type enhancements, and change languages through the printer's menu system. The 645's control panel houses a 16-character LCD screen, which displays the

menu options. The printer offers four configurations—default, current configuration, Powerup, and Alternate; the latter two can be saved and loaded as needed.

The 645's control panel is intelligently designed. From there you'll be able to use the form- and the line-feed controls whether or not the printer is on-line. Three separate buttons take you down a level in the printer's menu structure; if you want to return to a setting you just changed, hit the button for the lowest level (rather than all three in sequence) for a shortcut. Current settings are marked with an asterisk when shown on the LCD display.

The 15.5-by 31-by 19-inch (HWD) 645 uses two heavy-duty tractors to hurry continuous (only) forms past the printer's 66-pin head. (Its character matrix is 9 pins high; the 66 pins on the printhead are arranged horizontally.)



Mannesmann Tally's \$5,999 645 is a rugged, 77-pounder that works with mainframes, minis, and networked or standalone PCs.

As you might expect, it raises a bit of a racket in the process—86 decibels on our PC Labs Noise Test. A sturdy hatch brings the decibel level down to a more comfortable 75—its tabletop-use operating level.

For more sound protection as well as sturdy support, a pedestal is available for an additional \$500; another \$500 buys you a sound-muffling add-on for the pedestal. The FCC Class-A-rated printer is best situated 6 feet from a PC, if linked through its Centronics connector. If you use the DB-25 serial connec-

tion, you're best off moving the printer 15 feet away from the PC.

Our review model initially encountered a few difficulties with the controller card, on which its NVRAM chips are mounted. A few saved settings reset themselves without warning, and the LCD occasionally flashed "NVRAM Fault." A Mannesmann Tally technician replaced the card, ending these difficulties. In a similar end-consumer situation, your dealer or systems integrator would be the one to install the printer and ensure that no problems arise with it.

For an extra \$800, you can get the Graphics Processing Option, a controller board add-on compatible with QMS Code V versions 1 and 2. This add-on intercepts all graphics-mode data and allows the printing of block characters, bar codes, lines, and boxes. It also provides formatting control for placing these images where you want them.

The 645 is a printer for everybody—that is, everybody in a department or even a company. If your organization needs a fast, industrial-strength printer for printing multipart forms; one that can be shared among networked PCs, minicomputers, and mainframes; and one that can print specialty images like bar codes, then you should take a look at the 645.

Mannesmann Tally 645

Mannesmann Tally Corp., 8301 S. 180th St., Kent, WA 98032; (800) 843-1347, (206) 251-5524. **List Price:** \$5,999; graphic processing option (QMS code V version 2 compatibility), \$800; open pedestal assembly, \$500; noise reduction kit, \$500; rolling casters, \$70. **Standard Warranty:** One year on parts and labor. **Dimensions (HWD):** 15.5 x 31 x 19 in. **Weight:** 77 lbs. **Emulations:** Epson FX, IBM Proprinter, Mannesmann Tally 660/690, Printronix P600 Personal Line Printer. **In Short:** With a measured speed of 450.8 lines per second, this industrial-strength line printer delivers some of the best performance you'll ever see from a dot matrix product.

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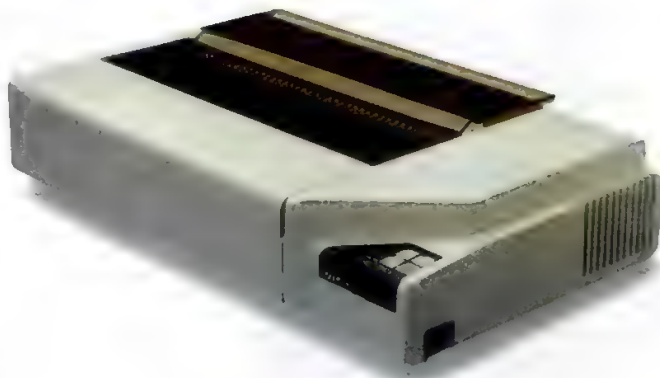
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**ALPS ASP1600**

ALPS Electric Inc., 3553 North First St., San Jose, CA 95134 (408) 432-6000.

List Price: \$299; serial interface, \$45.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 4.3 x 15.8 x 10.5 in.

Weight: 9.0 lbs.

Emulations: Epson FX, IBM Graphics Printer.

In Short: A good buy for low- to medium-duty use, the ASP1600 offers average—if not spectacular—performance and produces text of admirable quality for a 9-pin machine.

CIRCLE 615 ON READER SERVICE CARD

LED indicator lights and raised buttons to issue line feeds and form feeds and to bring the printer on-line and off-line. If you press the form feed and line feed buttons while you power up the printer, you'll switch it from Epson emulation in draft mode to Epson emulation in letter-quality mode. The printer uses DIP switches for setting such relatively arcane things as international character sets and for doing such workaday things as changing fonts. An included RAM-resident utility, *ALPSmate*, lets you control the printer from your keyboard.

For low- to medium-duty use in a small business, home office, or college dorm, ALPS' entry is a good value. If your printing ambitions match your budget, you'll find what you need in the ASP1600.

ALPS Allegro 500 ALPS Allegro 500XT

by Susan G. Thomas

Two years ago we gave ALPS Electric's Allegro 24 series an Editor's Choice award, citing the narrow- and wide-carriage 24-pin printers for their solid overall performance and their reasonable price (for reviews of these printers see *PC Magazine*, October 31, 1988). With its new narrow-carriage Allegro 500 (\$499) and wide-carriage Allegro 500XT (\$799) printers, which replace the Allegro 24 models, ALPS has once again come up

with some top-performing printers.

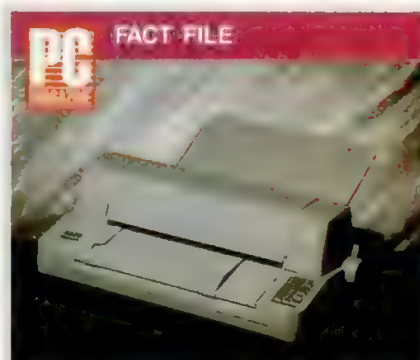
Differing only in carriage width, the ALPS Allegro 500 and 500XT offer the same features: an arched-dome cover, front L-path paper feeder, front-right control panel, back-right cable connect point, and back-side on/off switch. Both printers use cloth-ribbon harmonica cartridges and have paper parking—an option you can select from the control panel, which has both LED indicators and clearly marked, raised buttons.

Both printers can accommodate optional cut-sheet feeders. The \$198 automatic sheet feeder for the Allegro 500 can handle up to 80 sheets of paper at a time and even accepts postcards! The \$245 automatic sheet feeder for the Allegro 500XT can accept up to 200 sheets of paper or 30 envelopes. We found the latter unit frustrating to install. After several failed attempts, we were finally able to coax the sheet feeder into position. But even then the Allegro 500XT jammed a few times and printed 24-pound paper crookedly. ALPS reports that to its knowledge no other users have experienced this problem.

FONTS & FEATURES				
ALPS Allegro 500XT				
Epson LQ				
	Bold	Italic	Sub/Supr	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

Among the Allegro 500 and 500XT's resident type styles are Courier, Tiempo, Gothic, Bold Gothic, Script, and Bold Script. You can change fonts either by issuing escape codes or, in some cases, by pressing the MacroMind button on the control panel. A helpful feature that lets you tailor your settings and switch them quickly, MacroMind stores the printer's power-on defaults in two capacities: Macro mode and Memory mode. The former stores settings that are used or changed frequently, such as type style and pitch; the latter stores the print directions for graphics and other settings that are changed less often.

In our tests, the Allegro 500 and 500XT's default Epson LQ turned out impressive results. The 216-cps-rated Allegro 500 handled text skillfully, printing our test file at 113 cps in draft mode. In letter-quality mode, it also didn't make ALPS'

**ALPS Allegro 500****ALPS Allegro 500XT**

ALPS Electric Inc., 3553 North First St., San Jose, CA 95134; (408) 432-6000.

List Price: \$499 (500); \$799 (500XT); single-bin cut-sheet feeder (500), \$198; sheet feeder/envelope feeder (500XT), \$245; serial interface, \$35.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 6.7 x 18.0 x 11.8 in.

(Allegro 500); 8.4 x 23.3 x 13.8 in. (Allegro 500XT).

Weight: 12.8 lbs (500); 17.6 lbs (500XT).

Emulations: Epson LQ.

In Short: The narrow-carriage 500 and the wide-carriage 500XT offer 24-pin printing, a full range of features and fonts, and fast text printing—at a reasonable price. A MacroMind feature on both models makes it easier to switch among frequently-used settings.

CIRCLE 616 ON READER SERVICE CARD

rating of 72 cps, turning in a measured speed of 51 cps. We clocked the Allegro 500XT at 137 cps in draft mode and 68 cps in letter-quality mode. In all modes, the printers turned out text that was easy to read.

Both printers produced crisp, good-looking graphics in our tests, but they won't win any awards for speed. Among the slower printers in their price range, the Allegro 500 and 500XT both printed our test images at a rate of 0.5 gppm.

But chances are good that you'll be printing more text-based documents than graphics with these printers. In that case, both speed and quality will be on your side. With their wide range of features, the Allegro 500 and 500XT are good buys.

Brother M-1909

by Oliver Rist

When we reviewed the \$627 Brother M-1809 last year, we said that the reasonably priced 18-pin printer would be appealing to budget-minded users who were looking for fine, if not the best, monochrome and color output. This year we can say the same for the \$699 M-1909, Brother's

PRINTERS DOT MATRIX

FONTS & FEATURES

Brother M-1909

	Epson FX			
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

wide-carriage version of the M-1809.

You'll find faster speed and, perhaps, better print quality in more-expensive printers, but the Brother M-1909 still holds its own in both its default Epson FX and its IBM Proprinter emulations. In our tests, the printer turned in a draft speed of 129 cps under Epson FX emulation, a ways below Brother's rating of 350 cps. In NLQ mode, the printer gave a measured speed of 43 cps.

As you'd expect, print quality improves as speed decreases. In draft mode, text is light but legible. Letterforms are darker and thicker in NLQ mode, and even more so in LQ mode in both Prestige and Quadro type styles. Resident in the printer are 10 cpi, 12 cpi, and proportional fonts with such enhancements as boldface, superscripts and subscripts, and underlining. If those aren't sufficient, you can purchase Brother's \$149 LQ-400 font card, which allows the printer to use Anelia PS, Gothic, or Brougham LQ fonts.



Brother M-1909

Brother International Corp., 200 Cottontail Lane, Somerset, NJ 08875; (201) 981-0300

List Price: \$699; upgrade to 32K RAM, \$104; LQ-400 font card, \$149; CK-100 dealer-installed color option, \$78; TF-250 top tractor-feed attachment, \$133; SF-250 auto-cut sheet feeder, \$330.

Standard Warranty: One year on parts and labor, depot service.

Dimensions (HWD): 6.1 x 24.5 x 15.3 in.

Weight: 26.5 lbs.

Emulations: Epson FX/JX, IBM Proprinter.

In Short: A bit slower than its rated speed, the M-1909 is still a solid printer with good output and color capability at a competitive price.

CIRCLE 617 ON READER SERVICE CARD

The M-1909's monochrome graphics won't make you want this printer more than you would a laser printer, but they do retain subtle shades and details. In our graphics tests, the M-1909 yielded a measured speed of 0.7 gppm under Epson FX emulation. With the \$78 dealer-installed CK-100 color option, the machine turned in the same graphics time and its output was both bright and crisp.

The M-1909 handles paper in two

The Brother M-1909 handles paper through a rear-entry U-path tractor feed or through an L-path cut-sheet feeder in front.

ways: through a rear-entry U-path tractor feed or through an L-path cut-sheet feed in the front, directly behind the platen. Both methods worked reliably in our tests. Only heavy-stock paper jammed the printer. You can print with the stuff, but be prepared to lose the first and last sheet to the maw of the plastic platen cover. (The M-1909 displays an error message and won't come on-line if its cover is removed during printing, so that's not an option for dealing with heavy stock.)

Brother also offers a \$330 SF-250 cut-sheet feeder (150-sheet capacity) and a \$133 TF-250 top pull-up tractor for smoother multipart forms feeding. We tested the SF-250 cut-sheet feeder and found that it snapped into place easily and worked as expected. But, again, the unit faltered when handling heavy-stock paper.

Controls on the 6.1- by 24.5- by 15.3-inch (HWD) printer are clearly marked. Error and status messages are understandable, if occasionally cryptic. Line-feed, form-feed, on-line, menu-select, and load buttons are mounted on the front right of the unit, and the power switch is located on the top right toward the rear; all are easily accessible. Adjustable from the front panel are emulations, fonts, pitch settings, and even paper-handling options.

Brother's comprehensive manual explains all you'll ever need to know about

the printer, from setting it up to using its LCD display and menus. The company's technical writers present the material clearly and logically; plenty of informative line drawings help make the unit easy to set up and almost foolproof to use.

With a moderate list price, reliable performance, and the ability to produce quality monochrome and color documents, the Brother M-1909 is a good investment. Though somewhat pricey and not as fast as some, the M-1909 still does a commendable job.

Brother M-1924L

by Oliver Rist

Like Brother International's M-1909, which we reviewed in the preceding article, its new top-of-the-line M-1924L is a wide-carriage version of a printer that was introduced last year. Costing \$200 more than the narrow-carriage M-1824L, the \$949 M-1924L offers a 24-pin printhead, includes a generous number of fonts, and lives up to the L (for letter quality) in its name.

The M-1924L is the physical twin of the M-1909. Both printers measure 6.1 by 24.5 by 15.3 inches (HWD), weigh 26.5 pounds, and offer essentially the same front-panel controls. Native differences between the two lie mainly in their print-heads (the M-1909's has 18 pins rather than 24 pins) and standard emulations (the M-1924L offers IBM Proprinter, adds Diablo/Brother HR, and replaces Epson FX with Epson LQ-2500/LQ-2550 for color and Epson LQ-1050 for monochrome).

Like the M-1909, the M-1924L can accommodate a dealer-installable color option (\$78), an SF-250 cut-sheet feeder with

FONTS & FEATURES

Brother M-1924L

	Epson LQ			
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

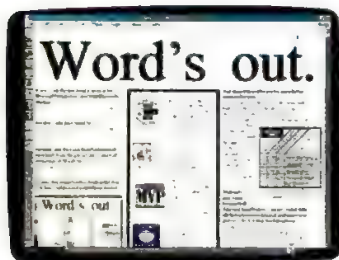
a capacity of 150 sheets (\$330), a TF-250 top-mounted tractor-feed attachment for smoother multipart forms feeding (\$133), and an upgrade to a 32K buffer (\$104). But whereas the M-1909 accepts a \$149 LQ-400 font card with fonts in three type styles, the M-1924L works with a \$155

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★★★★	7.6	8.1	Word Perfect
★★★★	7.2	6.7	Microsoft Word for Windows

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PRINTERS DOT MATRIX

LQ-600 font card with fonts in six type styles (OCR-A, Super Grande, Brother's versions of Times Roman and Helvetica, Script, and Symbol). It also can take a \$104 RAM downloadable font card, the RC-100.

Setting up the M-1924L is a piece of cake, just as it is with the M-1909. The detailed manual that comes with the printer facilitates installation, which took at most 30 minutes. A rear-entry tractor feed is the printer's main paper path, but it can also handle cut sheets through an L-path feeder on top of the unit behind the platen. In our tests, the unit handled multipart forms without a problem.

Only heavy stock gave the M-1924L difficulty. In tractor mode, the printer could print on heavy stock, but we'd lose the first page to a form feed and the last to a paper jam. Cut-sheet card stock was impossible to use.

The M-1924L comes well-equipped with fonts, among them draft, Brougham, Prestige, Gothic, Quadro, and OCR-B, and prints them nicely. Letterforms are clear and dark and come close to laser-printer quality. Text enhancements like boldface, subscripts and superscripts, and underlining are executed correctly.

Its graphics printing capabilities are equally impressive. Dot matrix printers

will probably never be able to match laser printers at producing quality graphics, but the M-1924L is one that tries. Compared with some of the lower-quality laser printers we saw this year, the M-1924L holds its own.

The M-1924L's measured text speed doesn't equal its 337-cps rating, but it's still respectable. In PC Labs' tests, the printer performed at about 122 cps in draft and at about 58 cps in LQ mode. In our graphics tests, the printer turned out high-quality images at a rate of 0.7 gppm.

With beautiful text and graphics, acceptable print speeds, and a wealth of options, this printer has a lot to offer business users. If you need high-quality output at a lower-than-laser price, the M-1924L can deliver.

Bull Compuprint 4/22 Bull Compuprint 4/23

by M. David Stone

Even if their respective \$499 and \$699 list prices suggest otherwise, the narrow-carriage Compuprint 4/22 and the wide-carriage Compuprint 4/23 are Bull HN Information Systems' low-end printers. These 9-pin dot matrix models offer automatic paper loading, a push tractor, IBM Proprinter and Epson FX emulations, and, most important, respectable speed and print quality.

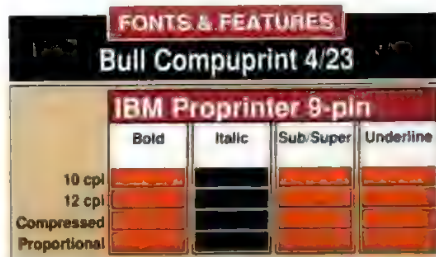
While, like all dot matrix printers, Bull's entries didn't print as fast as their claimed 200-cps draft rating, they were speedier than we had anticipated. In the PC Labs tests, the 4/22 turned in draft speeds of 117 cps under IBM Proprinter emulation and 118 cps under Epson FX emulation; the 4/23's times were 116 cps in IBM mode and 117 cps in Epson mode. In NLQ mode, the 4/22 came in at just under 34 cps for both emulations, and the 4/23 at about 38 cps for both—just as we had expected, given their claimed NLQ rating of 67 cps. Graphics speeds for both printers were an acceptable 1.4 gppm under IBM Proprinter emulation and 1.3 gppm under Epson FX emulation. And both printers handled multipart forms and heavyweight paper in our tests without a problem.

The two printers produce documents of the same print quality. In NLQ mode, text is smooth and dark. In draft mode, the individual dots of the letter forms are visible,

but the characters are still highly readable.

Although both units print acceptable graphics—our test scanned-photo and gray-scale images retained all but the smallest details—we did notice that solid black areas were a bit grayer than they might have been, and that the page had traces of horizontal white lines.

To get the most out of the Compuprint



4/22 or 4/23, you'll have to read the manual. For example, if you wanted to change one of the printers from its default emulation, IBM Proprinter, to Epson FX mode, you'd find yourself searching in vain through the menus for the right command. The only way to make that change is to hold the Program button down while you turn on the printer, a method that is anything but obvious. Unfortunately, the manual is a mixed bag. Most of the information you'll need is there. But since the manual lacks an index, it's not always easy to find.

You'll find the printers' front panel, which houses a 16-character LCD display and six control buttons, easy to use for most tasks. For example, when the printer is on-line, the LCD display shows the current font and pitch. To cycle through the choices—a Courier-like typeface in draft and letter-quality modes in pitches ranging from 5 cpi to 20 cpi—you tap the font button or the CPI button as appropriate. Both buttons also double as selection keys for the printer menus.

To set up the 10.5- by 17- by 14.3-inch (HWD) Compuprint 4/22 or 10.5- by 24- by 14.3-inch (HWD) Compuprint 4/23, you insert a ribbon, attach a paper separator, and plug a cable into either a parallel port, an oddball 9-pin DIN-connector serial port, or an optional \$135 DB-25 serial port. You then load paper, using either the push tractor for continuous-form paper or the paper separator's paper guide for single sheets. Conveniently, the push tractor lets you park fanfold paper out of the way, so you can feed cut-sheets without having to remove the fanfold paper entirely.

Bull HN Information Systems also offers a single-bin cut-sheet feeder at \$265



Brother M-1924L

Brother International Corp., 200 Cottontail Lane, Somerset, NJ 08875; (201) 981-0300.

List Price: \$949; upgrade to 32K RAM, \$104; LQ-600 font card, \$155; RC-100

RAM/downloadable font card, \$104; CK-100 dealer-installed color option, \$78; TF-250 top tractor feed attachment, \$133; SF-250 auto-cut sheet feeder, \$330.

Standard Warranty: One year on parts and labor, depot service.

Dimensions (HWD): 6.1 x 24.5 x 15.3 in.

Weight: 26.5 lbs.

Emulations: Diablo/Brother HR, Epson LQ, IBM Proprinter.

In Short: Excellent text, solid performance, and close-to-laser graphics make this color-capable machine a good buy for the money.

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Bull Compuprint 4/22
Bull Compuprint 4/23

Bull HN Information Systems, Technology Park,
Billerica, MA 01821-4199; (508) 250-9237.

List Price: \$499 (4/22); \$699 (4/23); font
cartridges, \$50; downloadable fonts, \$25; single-
bin cut-sheet feeder, \$265; second bin (4/22),
\$175; second bin (4/23), \$245; serial port, \$135.

Standard Warranty: One year on parts and
labor.

Dimensions (HWD): 10.5 x 17 x 14.3 in. (4/22);
10.5 x 24 x 14.3 in. (4/23).

Weight: 18 lbs. (4/22); 23 lbs. (4/23).

Emulations: Epson FX, IBM Proprinter.

In Short: The narrow-carriage 9-pin Compuprint
4/22 and the wide-carriage 4/23 offer satisfactory
graphics, readable text in both draft and NLQ
modes, and very acceptable speeds. They also
handle multipart forms and heavy-stock paper
without a hitch.

CIRCLE 619 ON READER SERVICE CARD

for the 4/22 or \$295 for the 4/23, a second
bin at \$175 for the 4/22 or \$245 for the
4/23, five font cartridges at \$50 each, and a
disk of downloadable fonts for \$25. Each
bin holds 100 sheets, but does not handle
envelopes.

All told, the Compuprint 4/22 and 4/23
are credible contenders in their price
range. If you're looking for an impact
printer for light- to medium-duty jobs,
these models are worth considering.

Bull Compuprint 4/24

by M. David Stone

Bull HN Information Systems' Compuprint 4/24 is identical to the vendor's Compuprint 4/23 dot matrix printer in all but a few significant ways (see the preceding article for a review of the Compuprint 4/23). For \$995—about \$300 more than the 9-pin 4/23—the wide-carriage Compuprint 4/24 offers a 24-pin printhead, different emulations, faster speed in some cases, and better print quality.

Rather than using the 4/23's 9-pin IBM Proprinter and Epson FX emulations, the 4/24 quite sensibly uses 24-pin IBM Proprinter and Epson LQ-1500 emulations,

two of the most common for 24-pin printers. These deliver print quality that falls into two categories: good and better. Even in draft mode, the 4/24 produces nearly fully formed characters. Unless you look very closely, you'll see characters that appear to be gray rather than composed of dots. Like that of many 24-pin printers, the 4/24's near-letter-quality text lacks the crispness of IBM Selectric-produced text, but its characters are dark, fully formed, and highly legible.

In testing, we clocked the Bull 4/24 at 113 cps in draft mode for both IBM and Epson LQ emulations, which was better than we expected, given the printer's rated speed of 200 cps. In NLQ mode, the printer came close to matching its claimed speed of 67 cps, printing at a surprisingly fast rate of 60 cps.

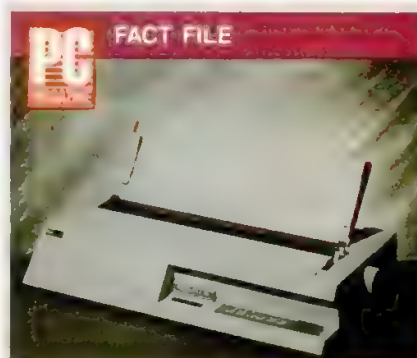
We saw significant differences in performance and print quality between the two emulations on the PC Labs graphics speed tests. Under IBM Proprinter emulation, the printer generated our test images at a rate of 1.1 gppm; under Epson LQ 1500 emulation, its speed was 2.0 gppm, and its rendering of our scanned photo image was more detailed than that of the Proprinter emulation. Still, we were able to detect hints of horizontal white lines in the black areas of our test images, just as we did with the 4/23's output.

In addition to using the same control panel and paper-handling features as the 4/23, the Compuprint 4/24 uses essentially the same manual and fonts. Its Courier-like typestyle goes by several names and sizes that correspond to the LQ-1500's fonts, including Sans Serif, Courier, Elite, and Micron, in NLQ mode.

The 4/24 can also accept the same single- and dual-bin cut-sheet feeder options

Bull Compuprint 4/24				
IBM Proprinter 24-pin				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

as the 4/23; the single-bin feeder costs \$295, and the second bin costs \$245. Each bin holds 100 sheets, but has no envelope-feed capability. As for the 4/23 model, the only other options for the 4/24 are font cartridges priced at \$50 each, and a disk of



Bull Compuprint 4/24

Bull HN Information Systems, Technology Park,
Billerica, MA 01821-4199; (508) 250-9237.

List Price: \$995; font cartridges, \$50;
downloadable fonts, \$25; single-bin sheet feeder,
\$295; second bin, \$245; serial port, \$135.

Standard Warranty: One year on parts and
labor.

Dimensions (HWD): 10.5 x 24 x 14.3 in.

Weight: 21 lbs.

Emulations: Epson LQ, IBM Proprinter.

In Short: A wide carriage, 24-pin printer, the
Compuprint 4/24 offers highly-readable text in
both draft and NLQ modes with measured
speeds of 113 cps for draft and 60 cps for NLQ
printing.

CIRCLE 620 ON READER SERVICE CARD

downloadable fonts for \$25.

Like the 9-pin Compuprint 4/23, the 24-pin Compuprint 4/24 is a credible printer for light- to medium-duty jobs. If you're looking for an impact printer that produces highly readable NLQ output at a reasonable speed, the Compuprint 4/24 should fill your needs.

Bull Compuprint 4/40

by M. David Stone

Although the 9-pin \$1,245 Compuprint 4/40 bears a family resemblance to Bull HN Information Systems' less-expensive 4/20-series 9-pin dot matrix printers, they share more differences than similarities, particularly because of the 4/40's color printing capability.

Like the 9-pin Compuprint 4/22, the 9-pin 4/40 offers both IBM Proprinter and Epson FX emulations, a push tractor, automatic paper loading, and the ability to park fanfold paper on its tractor while it is fed single sheets. It also offers the same fonts—a Courier-like typeface in draft and letter-quality modes in pitches ranging from 5 cpi to 20 cpi. That's about where the likeness ends.

First, the Compuprint 4/40 has two additional emulations—IBM Graphics and Epson JX—that handle color printing jobs,

and it can also print bar codes. Its narrow carriage is wider than the usual 100 columns, so you can feed the 12- by 19.8- by 15.8-inch (HWD) printer letter-size paper in landscape mode. (Bull HN Information Systems sells a wide-carriage version, the 4/41, for \$1,545. However, the company could not provide us with one in time for review.)

Optional cut-sheet feeders are available for the 4/40, but, at \$545 for the single-bin unit and \$295 for a second bin, they cost more than those for the 4/20 series. Each bin can hold 100 sheets; the first bin can hold 50 envelopes, a capability not available with the 4/20 series.

If the 4/40's resident fonts won't suffice, you can buy up to seven font cartridges from Bull for \$50 each—that's two more than for the 4/20 series—and a disk of downloadable fonts for \$25. And if you want a serial rather than a parallel port at purchase time, it'll cost you \$50. After that, it'll cost \$135 to change from either port to the other.

Getting started with the 4/40 is a bit more difficult than with Bull's 4/20-series printers. The 4/40 lacks a paper-feed knob, so that to use fanfold paper, you need to know about its automatic load feature and paper load lever. Since this lever is not labeled, it's unlikely you'll figure out how to load paper without reading the manual. Like Bull's other manuals, the 4/40's manual tells you most of what you need to know. Unfortunately, its index is sparse, so you may have trouble finding information quickly.

FONTS & FEATURES				
Bull Compuprint 4/40				
Epson FX				
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

Once you learn how to load paper into the 4/40, you'll find that the printer is straightforward to use. Its front panel has a four-character LED that displays status and menu settings, as well as on-line toggle, form-feed, line-feed, font control, and quality buttons, the latter of which is used for switching between draft and NLQ modes.

In the PC Labs tests, we clocked the 4/40's draft speed at 154 cps in both IBM Proprinter and Epson FX modes, which is considerably better than we had estimated,

PRINTERS DOT MATRIX



Bull Compuprint 4/40

Bull HN Information Systems, Technology Park, Billerica, MA 01821-4199; (508) 250-9237.

List Price: \$1,245; serial version, \$1,295; font cartridges, \$50; downloadable fonts, \$25; single-bin sheet feeder, \$545; second bin, \$295.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 12 x 19.8 x 15.8 in.

Weight: 28 lbs.

Emulations: Epson FX/JX, IBM Proprinter, IBM Graphics Printer.

In Short: The wider-than-normal "narrow" carriage of the 9-pin Compuprint 4/40 is 100 columns, or wide enough to load a letter-size page in landscape orientation. Text print quality is a strong point, with NLQ mode providing dark, crisp characters, and even draft mode proving highly readable. Color output, though, is the weakest feature of this printer.

CIRCLE 621 ON READER SERVICE CARD

given the printer's rated draft speed of 250 cps. In NLQ mode under both emulations the printer also fared quite well, printing at 55 cps. Its rated NLQ speed is 66 cps.

On our graphics speed tests, the 4/40's performance—1.6 gppm under Proprinter emulation and 1.4 gppm under FX/JX emulation—was only slightly faster than that of the 4/20 series. On our color graphics test, the printer slowed down to 0.5 gppm.

Text printing is one of the 4/40's strong points; it's too bad we can't say the same thing about the printer's graphics and color printing capabilities. NLQ text is dark and crisp. Draft text is lighter, but the characters look fully formed from a reading distance. On our gray-scale test, we found that the 4/40 couldn't reproduce the detail of the finest patterns and that it left horizontal white lines in areas that were supposed to be solid black. On our color tests, we saw either solid but muddy colors or clean, crisp colors marred by horizontal white lines. Suffice it to say that the 4/40's color printing is less than impressive.

Also a weakness is the printer's han-

dling of heavyweight paper and multipart forms. On the PC Labs tests, heavyweight paper jammed the printer whenever its fold reached the roller. Multipart forms wouldn't load without jamming, despite Bull's claim that the 4/40 can handle thicker forms than the 4/20 series.

If you need a printer that can produce high-quality color documents or print on thick multipart forms or heavyweight stock, the Compuprint 4/40 is obviously the wrong choice. Otherwise the printer has more going for it than it has going against it—but nothing that you can't get for about the same price from an inexpensive laser printer.

Bull Compuprint 4/43

by M. David Stone

Bull HN Information Systems' \$1,995 Compuprint 4/43 is both more and less than a wide-carriage version of the Compuprint 4/40 (see the preceding article for a review of the Compuprint 4/40). It's less, because it lacks an Epson JX emulation for color printing. It's more, because it includes an automatic top feeder, a special-interest feature that distinguishes the 4/43 from Bull's other printers.

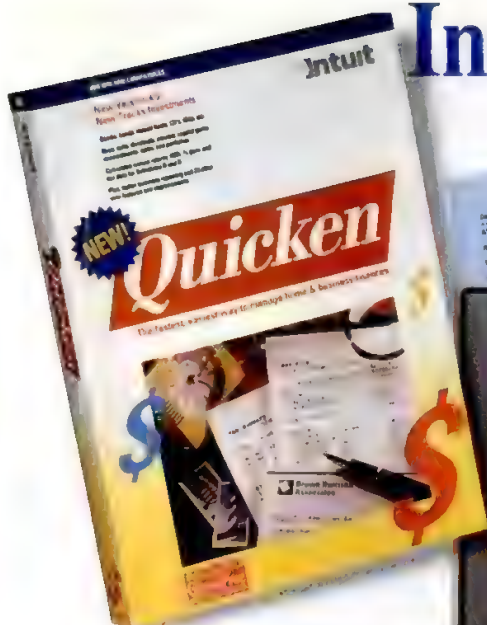
The automatic top feeder, which Bull calls a front feeder, is the type you've probably seen on printers in banks. It pulls paper down into the 4/43 for printing, then pulls it back out again, allowing you to print partly on a form and partly on tractor-

FONTS & FEATURES				
Bull Compuprint 4/43				
IBM Proprinter 9-pin				
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

feed paper, if you wish. In our tests, we found that this specialized feature worked as advertised, which may be the most you'll need to know about this printer.

In our text speed tests, the 4/43 printed at about 142 cps in draft mode under IBM Proprinter emulation and 147 cps in draft under Epson FX emulation. Like those of the other Bull printers we reviewed, these speeds were faster than we expected, given the printer's claimed speed of 250 cps. The 4/43 did particularly well in NLQ mode, with a measured speed of roughly 55 cps,

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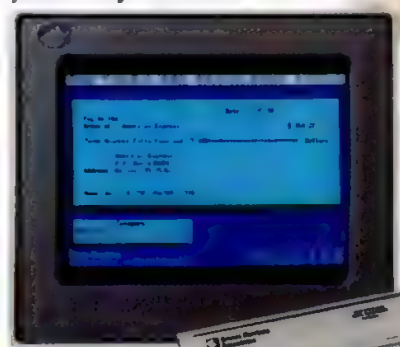
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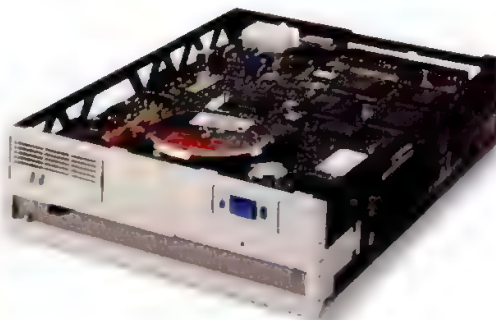
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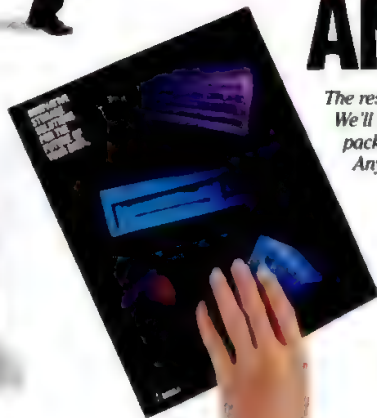
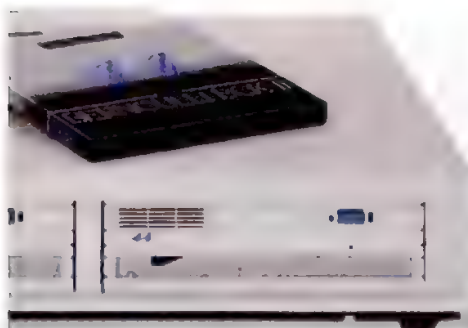


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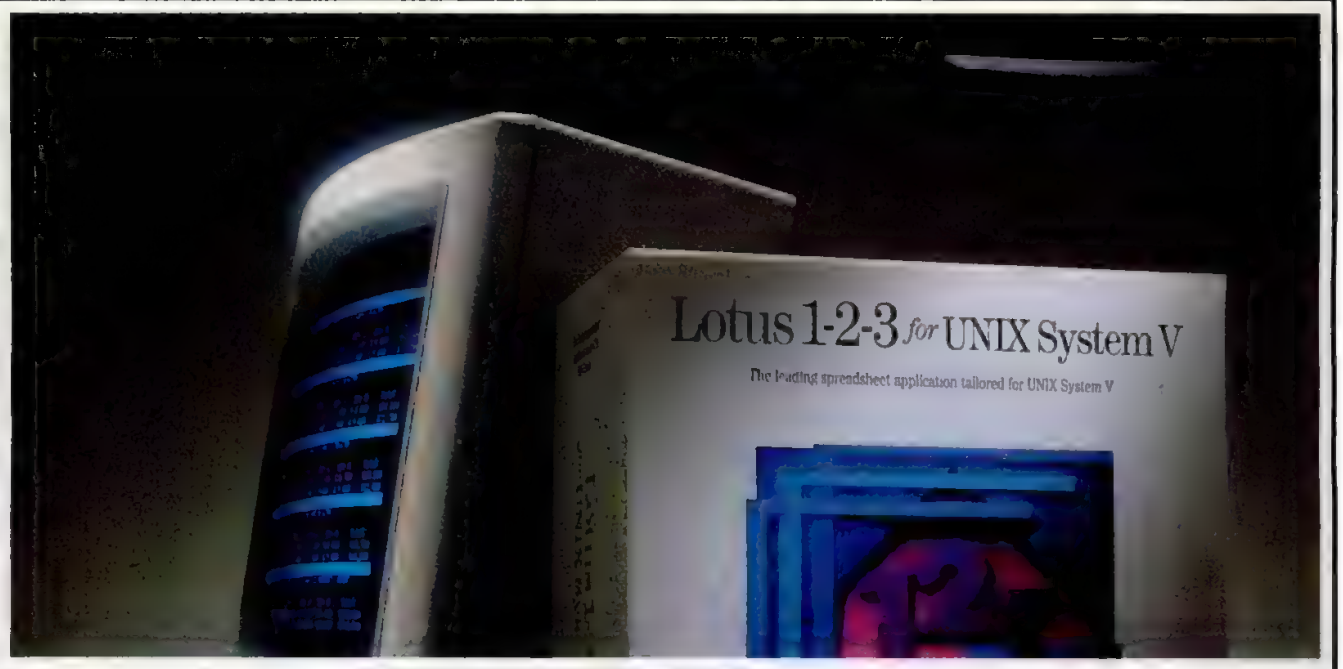
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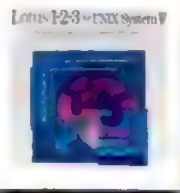
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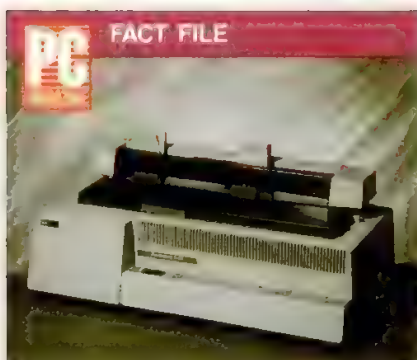
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Bull Compuprint 4/43

Bull HN Information Systems, Technology Park, Billerica, MA 01821-4199; (508) 250-9237.

List Price: \$1,995; font cartridges, \$50; downloadable fonts, \$25.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 9.5 x 24 x 12 in.

Weight: 31 lbs.

Emulations: Epson FX, IBM Proprinter, IBM Graphics Printer.

In Short: The top-mounted auto-feeder on the 9-pin Compuprint 4/43 is the sort of feeder used mostly in banks for savings passbooks. When you load paper through the auto-feeder, it pulls the paper into the printer and, after printing, spits the paper out again. If you need this sort of feeder, the printer is well worth the money. If you don't, there's no point in paying the premium.

CIRCLE 622 ON READER SERVICE CARD

PRINTERS DOT MATRIX

sheet feeders are available for the unit.

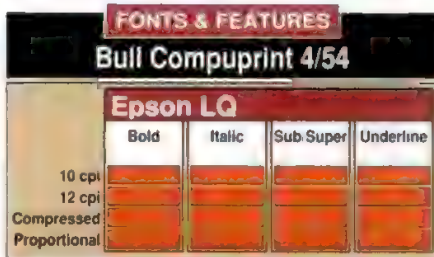
Clearly, these common features are not the 4/43's *raison d'être*. Its automatic top feeder is. Of course, you'll either need that capability or you won't. If you do, the price premium won't seem too excessive.

Bull Compuprint 4/54

by M. David Stone

When the price of a dot matrix printer approaches the upper limit of its category, the printer had better do everything well. For the most part, Bull HN Information Systems' \$1,995 24-pin Compuprint 4/54 does. Designed for heavy-duty printing jobs, the wide-carriage model offers fast speed, high-quality text and monochrome graphics, 24-pin IBM Proprinter and Epson LQ-2550 emulations, automatic paper loading, the ability to park fanfold paper while being fed single sheets, and color-printing capabilities. It's only in that last area that the 4/54 comes up short.

In draft mode, we clocked the 300-cps-rated 4/54 at about 168 cps under IBM Proprinter emulation and 165 cps under Epson LQ-2550 emulation. Those speeds are a



little more than 10 cps faster than those of the 9-pin Compuprint 4/40. Its measured speed in NLQ mode, 83 cps, is considerably faster than the 4/40's clocked speed of 55 cps.

The 4/54's NLQ speed is particularly impressive, because its print quality is so good. While the characters aren't as crisp as those that are printed on a good laser printer, they are certainly true-letter-quality—dark, solid, and fully formed. The printer's draft text is so good that it would qualify as correspondence-quality text on some printers.

Although the 4/54's speed on the PC Labs monochrome graphics tests—0.9 ppm in Proprinter mode and 0.8 ppm in Epson LQ-2550 mode—is less impressive, its print quality makes up for its slow-



Bull Compuprint 4/54

Bull HN Information Systems, Technology Park, Billerica, MA 01821-4199; (508) 250-9237.

List Price: \$1,995; font cartridges, \$50; downloadable fonts, \$25; single-bin cut-sheet feeder, \$395; second bin, \$295.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 12.3 x 24 x 12 in.

Weight: 31 lbs.

Emulations: Epson LQ, IBM Proprinter.

In Short: The 24-pin Compuprint 4/54 offers a little of everything—including a measured draft speed of about 165 cps, an even more impressive NLQ speed measured at 83 cps, and highly readable output. Color graphics are the weakest feature; if color is important to you, this is the wrong printer to get. For most other purposes, however, the 4/54 will be hard to outdo.

CIRCLE 623 ON READER SERVICE CARD

which is not far off from its 66 cps rating. Graphics speed was an acceptable 1.6 gppm under IBM Proprinter emulation and 1.3 gppm under Epson FX emulation.

Not surprisingly, the 4/43's text output is identical in quality to that of the 4/40. NLQ text is dark and crisp. Draft text is lighter, but the characters appear to be fully formed. The quality of the 4/43's graphics was just a notch better than it was for the 4/40. Here, too, the printer was not able to reproduce all the detail in the finest patterns on our gray-scale test. But it tended to produce fewer traces of horizontal white lines in solid whites. This ever-so-slight difference is probably attributable to variations between the individual printers we tested than to differences between the two models in general.

In just about every other way, the 9.5-by 24-by 12-inch (HWD) 4/43 is identical to the Compuprint 4/40. It offers the same push tractor, control panel, bar-code printing capability, and essentially the same manual as the 4/40, and it, too, lacks a paper-feed knob. The 4/43's font set is the same as that of the 4/40—a Courier-like typeface in draft and letter-quality modes in pitches ranging from 5 cpi to 20 cpi. Font cartridges are available for \$50 each, and a disk of downloadable fonts is available for \$25. No single- or dual-bin cut-

ness. The printer was able to reproduce all the detail, even in the smallest patterns, of our gray-scale and scanned-photo images, and it filled the solid areas of our test graphics with a truly solid black.

If you're looking for a printer that can produce high-quality color output, you'll be disappointed with the 4/54, since its color graphics are not on a par with its black-and-white graphics. In testing, the 4/54 produced either solid but slightly muddy colors or crisp colors with annoying horizontal white lines. Its speed on our color graphics tests was 0.6 gppm.

How well does the 4/54 handle heavyweight stock? On the PC Labs tests, the printer jammed at the bail when we tried it with heavyweight paper. But you can get around this problem by setting the printer for labels, so that it will automatically lift the bail at the beginning of each page. The 4/54 had no trouble handling multipart forms.

From its informative but poorly indexed manual to its lack of a paper-feed knob, the 12.3-by 24-by 12-inch (HWD) 4/54 is similar to the 4/40. But instead of using a 4-character LED on its front panel like the 4/40, the 4/54 uses a 16-character LCD. Other features include eight control buttons, among them an autoloader and pa-

per-park toggle, a font button, and a CPI button. The 4/54's Courier-like type style goes by several names and sizes that correspond to the Epson LQ-2550's fonts.

Our evaluation unit did not include a bar code printing feature, but according to Bull, one will be added in future firmware. If you buy a 4/54 that doesn't have this feature, Bull says you'll be able to get it as a free upgrade.

Options for the 4/54 are similar to those for the 4/40. They include a \$395 single-bin cut-sheet feeder, a \$295 second bin, six font cartridges at \$50 each, and a \$25 disk of downloadable fonts. The cut-sheet feeder holds 100 sheets per bin, and the first bin can hold 50 envelopes. You can also specify a serial port rather than parallel port for no additional charge, and can change from either port to the other at any time for \$135.

If high-quality color printing is one of your key needs, the Compuprint 4/54 is the wrong printer to get. But for almost any other task, you'll have a hard time finding a heavy-duty impact printer that outclasses the 4/54.

Bull Compuprint 4/68

by M. David Stone

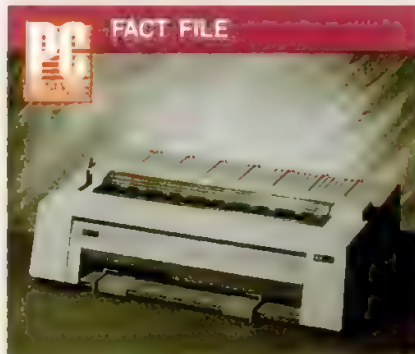
With a list price of \$2,545 and an estimated street price of \$2,295, Bull HN Information Systems' 18-pin Compuprint 4/68 is one of the few dot matrix printers that costs more than many laser printers, including the HP LaserJet III and the 10-ppm IBM LaserPrinter. But with its emphasis on color printing and handling multipart forms, the wide-carriage 4/68 is designed to do some things laser printers can't.

FONTS & FEATURES				
Bull Compuprint 4/68				
Epson FX				
	Bold	Italic	Sub/Supr	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

Raw speed is one of the 4/68's strengths. On our tests, the 400-cps-rated 4/68 printed at 192 cps, which translates into approximately 6.7 pages per minute, a speed that matches that of many laser printers. Even in NLQ mode the printer managed about 117 cps. Graphics speed is

PRINTERS

DOT MATRIX



Bull Compuprint 4/68

Bull HN Information Systems, Technology Park, Billerica, MA 01821-4199; (508) 250-9237.

List Price: \$2,545; font cartridges, \$50; downloadable fonts, \$25; IBM Proprinter XL emulation cartridge, \$150; single-bin cut-sheet feeder, \$695; second bin, \$445; pull tractor for bottom feed, \$200; serial port, \$155.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 7.3 x 24 x 16.5 in.

Weight: 44 lbs.

Emulations: Epson FX/JX, IBM Graphics Printer

In Short: With a higher list price than a LaserJet III, the 18-pin Compuprint 4/68 is meant for those who absolutely need a wide carriage, an impact printer, or both. Not surprisingly, one of the printer's strengths is raw speed—measured at 192 cps for draft mode. But you'll also find high-quality output for text, black-and-white graphics, and even color graphics.

CIRCLE 624 ON READER SERVICE CARD

also reasonably fast—2.0 gppm under Epson FX emulation and 0.7 gppm under Epson JX (color) emulation.

Even better than the printer's speed is the uniform quality of its output. NLQ text is solid, dark, and highly readable; draft quality text is somewhat lighter but still very clear. The printer can also print bar codes, but we did not test that feature.

The 4/68 also produces impressive graphics. Under the Epson FX emulation in our monochrome graphics test, the printer was able to reproduce all but the finest details in our gray-scale image and fill completely the solid black areas. Under the Epson JX emulation in our color graphics test, the 4/68 generated bright, crisp colors and smooth, solid areas.

Rather than offering IBM Proprinter emulation as it does with its other Compuprint models, Bull has chosen to provide IBM 5150 Graphics Printer emulation with the 4/68. But if you need Proprinter XL emulation cartridge for \$150. Built-in fonts include a Courier-like typeface in draft and letter-quality modes in pitches ranging from 5 cpi to 20 cpi.

Using the 4/68 is similar to using the other Bull printers reviewed in this issue. Its front panel offers a four-character LED for displaying menu options, and eight control buttons, including an on-line toggle, form-feed, line-feed, print-quality toggle, and font button. Not all of the 4/68's features are obvious; you'll need the manual to get the most out of the printer.

Among the 4/68's built-in paper-handling features are a push tractor, a paper-park capability, a cut-sheet feeder in the front of the printer, and a bottom feed slot for heavyweight paper. (To use the bottom feed slot, you need an optional \$200 pull tractor.)

Options for the 7.3- by 24- by 16.5-inch (HWD) 4/68 include a \$695 single-bin cut-sheet feeder, a \$445 second bin, 12 font cartridges at \$50 each, and a \$25 disk of downloadable fonts. The cut-sheet feeder holds 130 sheets per bin, but does not handle envelopes. A \$155 serial port option is also available for the printer.

All told, the Compuprint 4/68 is a premium printer at a premium price. Offering just about every feature you're likely to need, the printer has many strong points and no noticeable weaknesses. If the 4/68 is not the ultimate machine for heavy-duty impact printing, it will certainly do until something else comes along.

CIE CI-5000

by Ron Goldberg

When C. Itoh Electronics Inc. divided itself into three separate entities, CIE America emerged as the subsidiary responsible for marketing dot matrix business printers. As you might guess after taking a peek at the entry-level model in the CIE line—the

FONTS & FEATURES				
CIE CI-5000				
IBM Proprinter 9-pin				
	Bold	Italic	Sub/Supr	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

\$1,995 CIE CI-5000—the business-printer category comprises monster machines capable of enduring network and mini-computer duty. In terms of speed, paper-handling options, and overall flexibility, this 18-pin printer is to be taken very, very seriously.

A GRAPHIC DEMONSTRATION OF THE DIFFERENCE BETWEEN THE NEW BROTHER HL-4 PERSONAL LASER PRINTER AND THE HP IIP.



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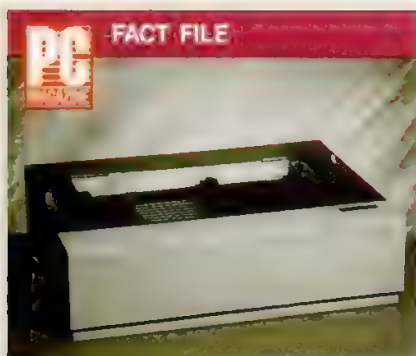


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**CIE CI-5000**

CIE America Inc., 2515 McCabe Way, Irvine, CA 92714; (800) 877-1421; (714) 833-8445.

List Price: \$1,995; upgrade to 64K, \$149; bar code cartridge, \$149; optional font cartridges, \$149; coaxial and twin-axial interfaces, \$1,200.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 6.3 x 22.8 x 23 in.

Weight: 33 lbs.

Emulations: Epson FX, IBM Proprinter, DEC LA Series

In Short: A powerful, rugged machine designed for network and other multiuser environments, the CIE-5000 delivers considerable speed and high-end configuration and paper-handling options.

CIRCLE 625 ON READER SERVICE CARD

CIE makes the target market for the CI-5000 clear from the start. The company rates the printer's duty cycle at 50 percent and its text speed at 540 cps. CIE also stresses the printer's Novell certification and handy "SpeedSet" feature, which allows up to five complete printer configurations to be stored and recalled upon demand either through software or through the printer's control panel. The company even built in emulations of the DEC LA series printers and added an RS-423 serial port for connection to DEC systems. Coax and twin-ax interfaces are available at \$1,200 apiece as options, in case you want to connect to an IBM 3270, System 3X, or AS/400. You also get standard PC connectors—a Centronics parallel and an RS-232—and emulations of the IBM Proprinter and Epson FX series.

As you might expect, the CI-5000 measures a bit larger than do most dot matrix printers, occupying a footprint of about 22.7 by 17.6 inches. A 15-character LCD display keeps you up to date on printer status and offers competent guidance for changing print parameters. This is a welcome feature, especially in light of the CI-5000 manual, which is one of the thickest and most confusing that we've come across during this roundup.

The CI-5000 eschews the membrane controls of many dot matrix printers in fa-

vor of good old-fashioned raised buttons. Although the unit comes with only an 8K buffer, CIE offers a \$149 upgrade that will bring the total to 64K.

The printer accepts fanfold paper through any of three routes: a rear, U-fold path; a bottom, vertical path; or a rear, L path. Of course, you also get a zero tear-off feature and paper parking, which is executed with two keystrokes using the front-panel's raised buttons. The CI-5000 handles up to 30-pound-weight stock, paper widths of 3 to 16 inches, and forms having up to six parts. The optional single-bin and dual-bin cut-sheet feeders won't be available until the first quarter of 1991 and have yet to be priced. Capacity will be 100 pages per bin.

The CI-5000 sticks to standard dot-matrix fare when it comes to resident fonts. The only resident typeface is Courier, which is available in numerous character pitches and spacings. Additional typefaces are available at \$149 per cartridge, with each cartridge containing two typefaces.

This printer gives you five choices for print mode: high-speed draft, draft, memo quality, near letter quality, and letter quality. Though it didn't come anywhere close to its rating of 540 cps in high-speed draft mode during the PC Labs benchmark tests, it still left most other dot matrix printers far, far behind.

Running in its default IBM Proprinter emulation, the printer clocked in at 250 cps in high-speed draft mode. In LQ mode, the CI-5000 became a bit more human, performing at a still-impressive 73 cps. In the Epson FX emulation, our text sample was churned out at 254 cps in high-speed draft and 72 cps in LQ. The CI-5000 also clocked in at a brisk 2.6 gppm on our graphics speed test.

Draft mode text was quite legible, and LQ text also looked fine, but neither was anything to get excited about. The same holds true for graphics, thanks to the printer's unspectacular 240- by 216-dpi maximum resolution. Then again, offering the sharpest text and smoothest images on the block isn't what this printer is all about.

CIE promises a color upgrade kit and a 200-line-per-minute line printer emulation cartridge for the CI-5000. Then again, we mentioned these options, as well as the still-unavailable cut-sheet feeder, last year when we reviewed the early version of this printer, the C. Itoh 5000 (see Printer Blockbuster Issue, November 14, 1989).

CIE estimates that these options will be available in the fourth quarter of 1990, but has yet to set prices. The bar-code cartridge is now available for \$149.

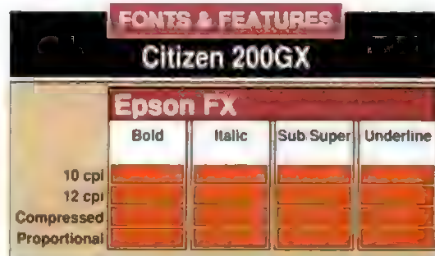
Who needs a printer like the CI-5000? If you have to ask, you probably don't. This machine is clearly meant for network duty and other applications that demand speed, flexibility, and unquestionable dependability. Perhaps our feelings about the CI-5000 were best summed up by the nickname one reviewer gave the printer before we packed it away: Roboprinter.

Citizen 200GX

by Margaret Piemonte

Last year we praised Citizen's 24-pin, dot-matrix entry—the \$499 GSX-140—for its speed, features, and high-quality NLQ text (see Printer Blockbuster Issue, November 14, 1989). The company's latest offering, the 200GX, puts the same advantages to work in a \$299, 9-pin package. The \$59 color option adds even more value to an already impressive package.

The 200GX presents few challenges during setup. Weighing only 11 pounds and occupying a footprint of 11.5 by 15 (WD) inches, the 200GX is easy to unpack and will fit nicely even in cramped workspaces. More important, especially for



first-time users, the manual offers useful help in every aspect of setup and includes detailed illustrations for potentially intimidating tasks such as installing the ribbon and attaching the paper guide. The control block includes a display panel and LED indicators to help guide you through selection of as many as 25 features using the four membrane buttons.

The printer uses a rear L-path for continuous forms and includes automatic paper loading capability, paper parking, and an automatic zero-tear-off function. An optional, \$49 printer stand allows bottom feeding but requires repositioning the built-in tractor to the pull position from its default push position. The printer accom-

FACT FILE

EDITOR'S CHOICE



Citizen 200GX

Citizen America Corp., 2450 Broadway, Suite 600, Santa Monica, CA 90404; (213) 453-0614.

List Price: \$299; auto cut-sheet feeder, \$169; manual sheet feeder, \$59; serial interface, \$49; color kit \$59; printer stand, \$49.

Standard Warranty: Two years on parts and labor.

Dimensions (HWD): 10 x 16.8 x 12.3 in.

Weight: 11 lbs.

Emulations: Epson FX, IBM Proprinter.

In Short: A competitive price and a wealth of options, including a user-installable color option, make this 9-pin narrow-carriage dot matrix a great choice for the home-office user.

CIRCLE 627 ON READER SERVICE CARD

modates paper up to 10 inches wide and a form thickness of up to 0.008 inches.

The 200GX has five resident typefaces: NLQ Roman, NLQ Sans Serif, NLQ Courier, draft, and high-speed draft. The 200GX emulates the Epson FX series as a default and can be configured to emulate the 9-pin IBM Proprinter via escape sequences or the control panel. One caveat: as with other settings made through the control panel, the switch to Proprinter emulation will remain active only as long as the printer stays on. You must configure the printer using its 16 DIP switches if you want the machine to retain settings permanently.

New to the Citizen line of printers is the Color On Command feature. This \$59 user-installable option comes with a four-color ribbon and drive motor and emulates the Epson EX color dot-matrix printer.

In the PC Labs speed test, the 200GX printed at 127 cps in high-speed draft mode and 36.8 cps in NLQ running under the Epson emulation. As one might expect, text quality suffered in high-speed draft mode. In NLQ mode, however, the 200GX generated output comparable to that of a 24-pin printer. You won't mistake it for laser output, but the characters rise above the grainy look that many 9-pin printers produce.

The printer completed our graphics sample at a rate of 1.2 gppm in monochrome mode and 0.4 gppm with color

PRINTERS

DOT MATRIX

graphics enabled. The monochrome graphics were about what you'd expect from a 9-pin printer: nothing terrible and nothing great. In our color tests, the printer generated colors that were somewhat darker and richer than the intended colors and those the Epson EX would produce, but the printer nevertheless produced a fair representation of the screen, suitable for simple business graphs and charts.

For first-time users, the 200GX is more than adequate for the home office marketplace and, with the addition of the color options, becomes a versatile office tool with superior, if somewhat slow, NLQ text capabilities.

Citizen GSX-140

by Carol Levin

Citizen America Corp. added the \$499, 24-pin GSX-140 to its line of dot matrix printers in 1989 to appeal to entry-level buyers (see Printer Blockbuster Issue, November 14, 1989). Now that the optional, \$59 color kit is available, Citizen is also positioning the GSX-140 as a color-proofing device for engineering, industrial design, marketing, and art departments, where the 360- by 360-dpi unit would complement a non-impact printer.

As it did one year ago, the GSX-140 emulates the IBM Proprinter and Epson

FONTS & FEATURES				
Citizen GSX-140				
Epson LQ				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

LQ series printers and boasts a power-packed control panel with a 16-character display, top-quality text and graphics output, two paper paths for continuous forms, paper parking, and four NLQ fonts: Courier, Prestige, Roman, and Sans Serif. The printer accepts paper as wide as 10 inches and forms up to four parts thick. Citizen's full assortment of options includes the \$49 serial interface, \$49 printer stand, \$69 upgrade from 8K to 40K RAM, \$169 single-bin automatic cut-sheet feeder, and \$59 manual sheet feeder. The company has a two-year warranty for the machine and of-

FACT FILE

EDITOR'S CHOICE



Citizen GSX-140

Citizen America Corp., 2450 Broadway, Suite 600, Santa Monica, CA 90404-3060; (213) 453-0614.

List Price: \$499; upgrade to 40K RAM, \$69; color option, \$59; automatic sheet feeder, \$169; manual sheet feeder, \$59; RS-232C serial interface option, \$49; printer stand, \$49.

Standard Warranty: Two years on parts and labor.

Dimensions (HWD): 13.5 x 16.8 x 6.8 in.

Weight: 12.1 lbs.

Emulations: Epson LQ, IBM Proprinter.

In Short: The Citizen GSX-140 is a narrow carriage, 24-pin dot matrix printer that produces superb output with or without its color option. It also offers a full assortment of features—all in all a bargain at its price.

CIRCLE 626 ON READER SERVICE CARD

fers 24-hour technical support through a phone number listed on the back cover of the manual.

It took about ten hassle-free minutes to install the color ribbon and the color motor unit, which connects to a port inside the machine. Of course, you must also push a few keys on the control panel.

Once you've made these changes, you can expect excellent color results with the GSX-140. Running under its Epson LQ-2500 emulation, our unit generated color graphics that compared favorably to those of the Epson. As with most color dot matrix printers, the colors appeared a bit darker than intended, but the Citizen seemed to have a slight edge over the Epson in color saturation. The Citizen's colors appeared a bit deeper and more homogeneous, and the image overall looked slightly cleaner.

When it comes to speed, a color-equipped GSX-140 holds its own, at least when compared with printers in its price range. Our color graphics image printed at a rate of 0.6 gppm. Still equipped with the color option, our unit printed our monochrome test image at a rate of 0.8 gppm under the Proprinter emulation. Printing monochrome text, the GSX-140 matched or bettered last year's performance, clocking in at 102 cps in high-speed draft mode and 44 cps in LQ mode.

Last year, we complained that the

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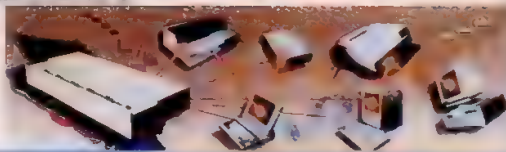
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CI-1000: More Expensive Than Most Laser Printers—and Worth It

by M. David Stone

If you're able to take your mind off the fact that CIE America's top-of-the-line impact printer costs \$9,995, you'll notice that the CI-1000 prints high-quality documents and handles multipart forms at speeds that would put most laser printers to shame. You'll also observe that this 110-pound wide-carriage printer does its job a line at a time rather than character by character.

Appropriate for departmental or data center use, the floor-standing CI-1000 line printer will grind out huge reports, streams of multipart forms, or whatever else you ask of it. That's because its 68-pin printhead, which is almost as wide as the wide-carriage paper it strikes, bangs out a line of 132 characters in the same amount of time as it would a line with a single character.

You won't find many impact printers that can match the CI-1000 in speed and output quality. In PC Labs' tests, the 940-line-per-minute (as rated by CIE) CI-1000 performed at 199 lpm in LQ mode and at 560 lpm in default draft mode. (We obtained all of the CI-1000's performance times using our laser-printer speed tests rather than our dot-matrix speed tests, since like a laser printer the CI-1000 takes noticeably longer to print the first page than it does to print subsequent pages.) As a point of reference, equivalent speeds in pages per minute would be 4.8 ppm for LQ mode and 13.5 ppm for draft.

These results do not tell the whole story, however. A high-speed draft mode that eliminates descenders can bring the CI-1000's speed to 661 lpm, according to our tests. And, if you set the printer for high-speed draft and upper case only, the speed jumps another 100 lpm to 760 lpm, or the equivalent of 18.3 ppm. All of these results reflect the printer's speed under its default CIE-DLP emulation.

In addition to offering an LQ mode, the CI-1000 provides an NLQ mode; both yielded identical performance times on our tests but used different fonts. The LQ mode uses a Courier-like serif font, while the NLQ mode uses a

Sans Serif font. Text in both modes is quite readable, with letterforms that are dark and solid.

As you might expect, text becomes significantly less readable when it is printed in high-speed draft mode. Not only can you easily see the individual dots of the letterforms, but their lack of descenders (the part of a letterform that falls beneath the "line," such as the loop on a lower-case j) forces them into unusual and hard-to-read shapes. Upper-case high-speed draft output is easier to decipher, but it is still not the sort of text you'll want to read much of in one sitting.

The CI-1000 is also fast at printing graphics, with a measured speed of 3.1 gppm under IBM Proprinter XL emulation. The printer reproduced all but the most detailed patterns of our gray-scale test image, and filled in solid areas with a dense black. But its rendering of our scanned photo had a posterized effect.

The CI-1000 is straightforward to use, thanks to a set of control buttons, LEDs, and a 15-character LCD display that shows the printer's options. You choose the emulation from a series of menus. Although its IBM Proprinter XL emulation probably will be of most interest to PC users, the CI-1000 also offers two Printronix 6000 emulations, both of which are supersets of DEC LG01 and DEC LXY modes, in addition to its default CI-DLP mode.

The CI-1000 accepts paper through a bottom-slot vertical-path feeder. Replacing paper is more cumbersome than it might be, since you have to load the bottom push tractor by reaching up through the printer's sound-muffling stand. Once it is securely placed in the bottom tractor, the paper is automatically loaded into the top tractor. If you add an optional \$149 top cover, the bottom push tractor allows for zero-clearance tear-off—a nice touch.

Other add-ons for the CI-1000 include a \$995 QMS Magnum Bar Code option, a \$1,200 Twinax connector module, and a \$1,200 Coax connector module. Font cards should be available by sometime early next year; each \$149



The \$9,995 CI-1000's 68-pin printhead bangs out a whole line at a time.

card will contain two fonts.

Finally, the printer does its work quietly enough that you can share an office with it; but given its \$9,995 base price and high-volume orientation, the CI-1000 is more likely to end up in a communal area than in a private office. ■

CIE CI-1000

CIE America Inc., 2515 McCabe Way, Irvine, CA 92714; (800) 877-1421; (714) 833-8445.

List Price: \$9,995; top tear-off option, \$149; Coax connector module, \$1,200; Twinax connector option, \$1,200; QMS Magnum Bar Code option, \$995.

Standard Warranty: One year on parts and labor. **Dimensions (HWD):** 41.3 x 27.5 x 21 in. **Weight:** 110 lbs.

Emulations: IBM Proprinter, CI-DLP, Printronix 6000 Series. **In Short:** One of the few line printers of interest to the DOS world, thanks to the IBM Proprinter compatibility, the CI-1000 offers surprisingly high-quality output at line printer speeds—ranging from a low of about 200 lpm for letter quality text, to about 760 lpm for high speed draft.

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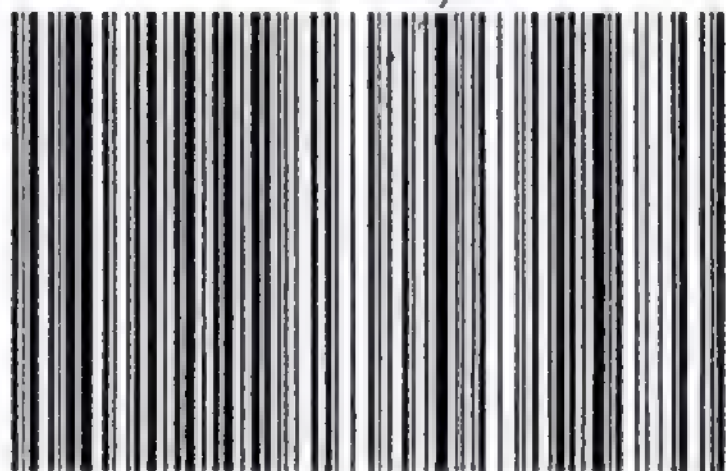


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1. Follow instructions on the other side

Back

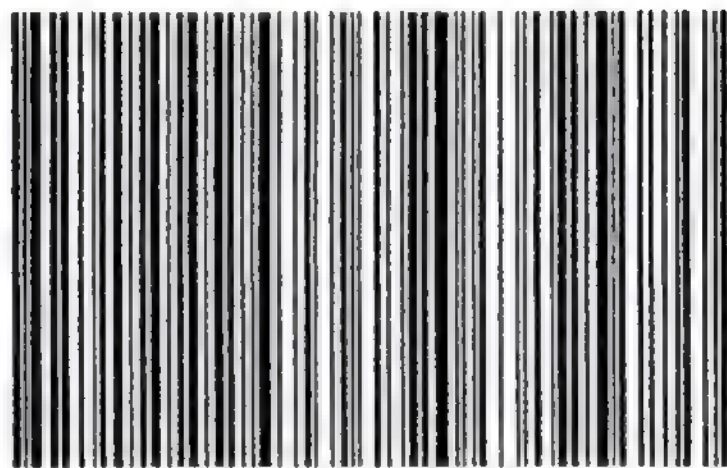
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Inverted Back

1. Follow instructions on the other side

Folded edge of the page



Inverted Foldout slip-sheet

Foldout slip-sheet

1. Open the foldout page

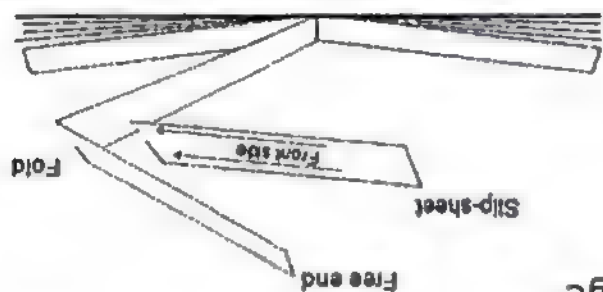
2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet



1. Open the foldout page

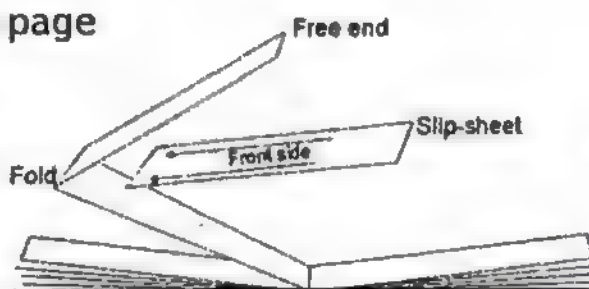
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Graphics Adaptor: Pro-Designer II

Spec: Expandable to 1 MEG; Non-interlaced at 1024 x 768

Reason: To allow 256 colors at 1024 x 768, as opposed to a 512K card only getting 16 colors. Non-interlaced at 1024 x 768.



Hard Drive/ Controller: Mitsubishi MR 535 Hard Drive

Spec: 65 MEG; 24 MS Access Time.

Reason: A name that assures reliability. One of the fastest access times on the market for a drive of comparable size.



Adaptec 2372C Controller

Spec: 8K Cache on Board

Reason: The fastest RLL data transfer rate on the market. Data transfer Rate: 1020 kilobytes per second.

MICROPOLIS Hard Drive/ Controller: Micropolis 1654-7 Hard Drive

Spec: 160 Meg; 16 MS access time.

150,000 HR Mean time between failure

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Ultrastor Ultrastor 12F controller

Spec: 32K Cache on board

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GSX-140 was noisier than most dot-matrix printers and cited its 82-decibel score on the PC Labs noise level test. This year, the printer tested at 74 decibels, a noise level much more typical of dot-matrix printers.

All in all, the Citizen GSX-140 represents a significant value. Its combination of excellent all-around print quality, power-packed control features, ample paper-handling options, and respectable speed make it an appealing printer. Add the \$59 color upgrade kit and you have a very capable color printer at a bargain price.

C-Tech ProWriter C-240 C-Tech ProWriter C-245

by Ron Goldberg

C. Itoh Co. Ltd. of Japan is still C. Itoh Co. Ltd. of Japan, but its former U.S. subsidiary, C. Itoh Electronics Inc., recently diversified into three separate companies: C-Tech Electronics Inc., CIE America Inc., and Image Systems Inc. C-Tech walked away from the diversification with the job of targeting microcomputer and office printers. While that may sound a bit vague, it basically means that this subsidiary's turf covers dot matrix printers with rated speeds up to about 400 cps.

The C-Tech C-240 and C-245 are the 9-pin entry-level machines in the new

FONTS & FEATURES				
C-Tech ProWriter C-245				
IBM Proprinter 9-pin				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

C-Tech line. Designed with the "no-nonsense" styling characteristic of C. Itoh Electronics' former offerings, both printers target users who need reasonable performance on a reasonable budget. Neither delivers extraordinary value or performance.

The C-240, which carries a list price of \$449, is a plain-vanilla narrow-carriage printer with a rated speed of 240 cps. It handles paper up to 10 inches wide and emulates both the IBM Proprinter XL and

PRINTERS DOT MATRIX

Epson FX 800/1000. Weighing in at 18.7 pounds and staking out a 21.5- by 12-inch footprint, the C-240 is a bit bigger than some of the offerings in its category.

Although boasting little in the way of advanced features, the unit partially makes up for its modest aspirations by including a few surprises, most notably a 19K buffer and an RS-232 serial port in addition to the Centronics parallel port.

For all intents and purposes, the C-245 is the same printer with a wider carriage. This model handles paper up to 15 inches wide and carries a list price of \$559.

Both the C-240 and C-245 offer passable text quality—nothing more, nothing

The C-Tech C-240, a plain-vanilla narrow-carriage printer, adds a few surprises, such as a serial port and a 19K buffer.

less—and neither one turned in particularly fast test results. In its default Proprinter mode, the C-240 spun draft-quality text at 113 cps. In NLQ mode, the pace slackened off to 32 cps, allowing us an extra gulp or two of coffee before we could review the results.

The C-245 performed only slightly more leisurely than its smaller sibling, turning out just over 110 cps in draft mode and a lumbering 32 cps in NLQ under the IBM emulation.

In the graphics tests, both machines printed coarse versions of our test image at a rate of 1.1 gppm in its default IBM Graphics mode.

Both printers use the tried and true U-fold paper-loading scheme, which worked without a problem throughout testing. Both offer selectable automatic paper positioning and a 1-inch tear-off, with a micro-adjustment feature that helps with precise positioning of forms.

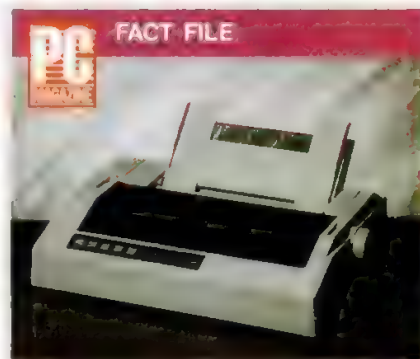
C-Tech includes paper parking and a single-sheet guide; an optional single-bin cut-sheet feeder is available at a price of \$145 for the narrow-carriage version and \$275 for the wide carriage. Both printers

are rated as handling forms with up to four parts, and neither had problems with our three-part carbon forms. Our heavy card stock, however, managed to stop the C-240 dead in its tracks, though the C-245 handled it just fine.

Printer configuration takes a bit of getting used to. The on-line switch works in tandem with the top-of-form and line-feed buttons to change menus and options, but each of these buttons uses increase and decrease arrows, making the appropriate course of action at any point a bit difficult to remember. If you intend to change the basic configurations on a regular basis, you'll either have to refer to the well-written manual or leave a small cheat-sheet near the printer.

Besides a default draft font, the printers come with two NLQ typefaces, roman and sans serif. A row of LEDs on the front panel indicates whether NLQ mode is active at any given time and gives the character pitch: 10, 12, 15, 17, 20, proportional, or condensed. C-Tech reports that font cards are not yet available. Operation was reasonably quiet—and thankfully so, since neither offers any kind of quiet mode. The construction of both printers was admirably solid.

With 9-pin dot matrix printers having come into their own in the past year in terms of speed, features, and low price,



C-Tech ProWriter C-240
C-Tech ProWriter C-245

C-Tech Electronics Inc., 2515 McCabe Way,
P.O. Box 25138, Irvine, CA 92714-6297; (800)
347-4017; (714) 833-1165.

List Price: \$449 (C-240), \$559 (C-245); single-bin sheet feeder (C-240), \$145; single-bin sheet feeder (C-245), \$275.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 4.6 x 16.9 x 12.4 in. (C-240); 4.6 x 22.5 x 12.4 in. (C-245).

Weight: 18.7 lbs. (C-240); 22.1 lbs. (C-245).

Emulations: Epson FX, IBM Proprinter.

In Short: While competent and ruggedly built, these 9-pin printers offer nothing new in terms of either design or capabilities, and cost more than some of the more-capable competition.

CIRCLE 628 ON READER SERVICE CARD

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it's hard to get excited over the C-240 and C-245. You can probably do better than these machines if your needs call for snazzy hard copy at an entry-level price. On the other hand, one has to wonder if the little whiz-bang unit that offers all those advanced features for that shockingly low price will outlast your first ream of paper. The C-Techs definitely will.

C-Tech C-510 C-Tech C-515

by Ron Goldberg

The C-Tech C-510 and C-515 come to the dot matrix scene as C-Tech Electronics' 24-pin entry-level candidates. The C-510 lists at \$639 and will handle cut sheets or fanfold paper as wide as 10 inches. The \$749 C-515 is essentially the same machine with a wider carriage, handling sheets as wide as 15 inches. Like their 9-pin counterparts, the C-Tech ProWriter 240 and C-Tech ProWriter 245, neither of these printers is particularly innovative (see preceding review). Instead, they offer dependability, versatile performance, and reasonable bang for the buck.

Apart from their cabinets and other differences involving their 24-pin design—most notably their emulations—the C-510 and C-515 offer the same feature set

FONTS & FEATURES				
C-Tech C-515				
IBM Proprinter 24-pin				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

as the C-240 and C-245. You get the same arcane setup procedure, the same membrane-button control panel, and the same capable paper-handling features and options. You also get the same solid construction. Performance, of course, is a bit different.

In its default IBM Proprinter mode, the C-510 meandered through our graphics speed test at a ponderous 0.4-gppm pace, only to reward us with a coarse, out-of-proportion image. Suffice it to say that if graphics figure heavily in your printing plans, these may not be the best machines for you.

Text results were satisfactory. The C-510 performed at 111 cps in draft mode



C-Tech C-510
C-Tech C-515

C-Tech Electronics Inc., 2515 McCabe Way,
P.O. Box 25138, Irvine, CA 92714-6297; (800)
347-4017; (714) 833-1165.

List Price: \$639 (C-510); \$749 (C-515); font
cards, \$40; single-bin sheet feeder (C-510),
\$145; single-bin sheet feeder (C-515), \$275.
Standard Warranty: One year on parts and
labor.

Dimensions (HWD): 4.6 x 16.9 x 12.4 (C-240);
4.6 x 22.5 x 12.4 (C-245).

Weight: 15.43 lbs. (C-510); 19.84 lbs. (C-515)

Emulations: Epson LQ, IBM Proprinter.

In Short: These solidly-constructed, 24-pin
printers offer reliability and average speed at a
higher-than-average price.

CIRCLE 629 ON READER SERVICE CARD

and 49 cps in LQ; the C-515 clocked in at 110 in draft and 50 in LQ. As should be expected with a 24-pin printer, text was highly legible in both draft and LQ modes, although draft text looked more like draft copy than we would have liked. The C-510 and C-515 depart from the font capabilities of the C-Tech 9-pin models only in their accommodation of optional font cards, which contain one additional typeface per card at a cost of \$40.

Our tests confirmed the company's claim of care-free tractor-feed operation: Once the fanfold paper was loaded, we never had to look back. The paper-parking feature worked well, though activating it requires several keystrokes, and both printers did a nice job with multipart forms, down to the last carbon. Our heavy card stock printed without a glitch.

Perhaps the strongest card this tandem has to play is its generous internal memory. A 28K buffer puts these machines near the head of their class, which should free up your PC for more important jobs than waiting on your printer.

The C-510 and C-515 are capable of handling a variety of word processing and spreadsheet tasks, but it seems that simple competency just isn't enough in today's world. If your printing needs are straightforward and dependability is your top con-

cern, you might want to check out the C-510 and C-515. But if graphics capabilities or hyperspeed are on your printer wish list, these two printers may seem a bit prosaic for their price.

C-Tech C-610 Plus C-Tech C-610C Plus

by Ron Goldberg

Last year we awarded the color-capable C-Itch C-610 an Editor's Choice—primarily for its excellent forms-handling capability, solid design, and low \$799 price (see Printer Blockbuster Issue, November 14, 1989). A year later, C-Tech has picked up where C. Itch left off, evolving the C-610 into the monochrome \$799 C-Tech C-610 Plus and the color-capable \$859 C-610C Plus. The "Plus" at the end refers not only to a small step up in price but also to a few enhancements; most notably, greater speed and the ability to accept font cards.

Like its predecessor, the C-610 Plus is a 24-pin flatbed dot-matrix printer that offers an unusual straight-through paper path. Fanfold sheets load from the back into the machine's internal pins and travel straight to the adjustable tray at the front of the printer. To accommodate this unusual scheme, the printhead in the C-610 Plus uses what the company calls a "heads up" design, bringing the pins straight down onto the paper.

The advantages of this system are obvious: the less convoluted the paper path, the less chance there is for a jam, especially

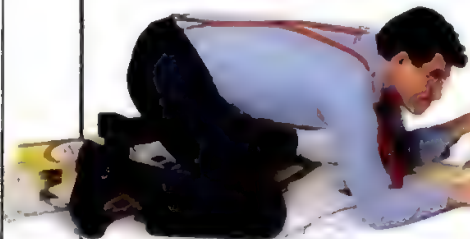
FONTS & FEATURES				
C-Tech C-610C Plus				
Epson LQ				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

when using heavy stock or multipart forms. On the other hand, it's somewhat disconcerting at first to see your copy come out head first and face up, so that reading the text from the front is nearly impossible.

Both printers, identical but for the color capability of the C-610C Plus, accommodate paper as wide as 11 inches and, as one of this design's primary advantages, as thick 0.014 inches. Naturally, the printers do a nice job with multipart forms, up to

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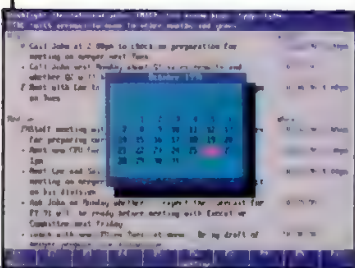
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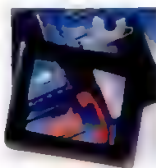
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CIRCLE 302 ON READER SERVICE CARD

enough to join the army of happy Norton Utilities users, it is.

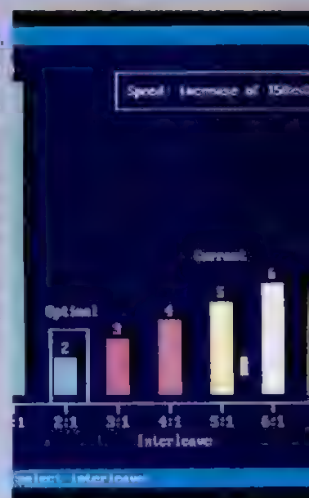
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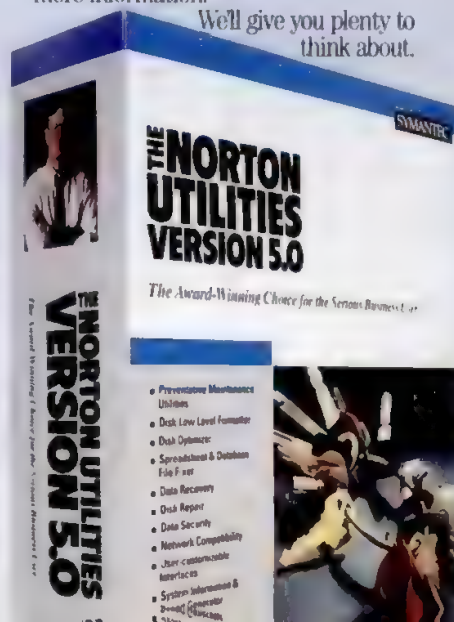
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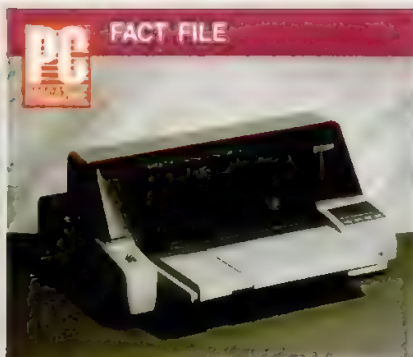
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The new Norton Utilities 5.0 from Symantec



C-Tech C-610 Plus
C-Tech C-610C Plus
 C-Tech Electronics Inc., 2515 McCabe Way,
 P.O. Box 25138, Irvine, CA 92714-6297; (800)
 877-8445; (714) 833-8445.
List Price: \$799 (C-610 Plus); \$859 (C-610C
 Plus); font cards, \$40; auto sheet feeder, \$299.
Standard Warranty: One year on parts and
 labor.

Dimensions (HWD): 8.3 x 18.3 x 13.8 in.
Weight: 26.5 lbs.

Emulations: Epson LQ, IBM Proprinter.

In Short: The C-610 Plus and the color-capable
 C-610C Plus, both 24-pin, standard-carriage
 printers, feature a straight-through paper path
 that gives them impressive paper-handling
 abilities.

CIRCLE 630 ON READER SERVICE CARD

their rated maximum of five parts. Both also offer paper parking and zero tear-off. The output tray at the front of the printer doubles as the single-sheet feed. In its default configuration, the printer slides the page in for printing and then slides it back onto the front tray. You can also have the page exit at the rear.

As for performance, graphics speed was rather slow on PC Labs benchmark tests: only 0.4 gppm in the default IBM Proprinter mode. The C-610C Plus is identical to the C-610 Plus, but with color drivers added. Surprisingly, printing with color did not slow graphics performance. Our unit ran good-resolution color in about 0.4 gppm.

Text speed fared slightly better than graphics performance. Using its Proprinter emulation, the C-610 Plus cranked out text at an acceptable 113 cps in draft mode and 48 cps in LQ. Text quality was good, offering fine LQ quality and highly readable draft.

Setup for both machines was simple, with connections being made through either a Centronics parallel or an RS-232C serial interface. Because of the unique physical layout of these printers, their footprint is deceptively large. Once the front paper tray is installed, these units demand a good amount of elbow room. And be-

PRINTERS DOT MATRIX

cause of their unique loading system, they require you to bend far, far over the top of the machine or approach it from the back to load paper: there's simply no other way to get a good enough view of the tractor pins inside the machine. Needless to say, loading the paper can be a frustrating experience.

The C-610 Plus was easy to configure, thanks primarily to a single-line LCD display. The display tells you everything you need to know, allowing you to cycle through the different pitches and emulations in a logical fashion, and a series of LEDs keep you abreast of important news like "LQ active" and "paper out." Beneath these LEDs are the company's fa-

**The 610 Plus was easy
 to configure, thanks
 to a single-line, 16
 character LCD.**

**The display and the
 front panel's LEDs
 tell you everything
 you need to know.**

miliar membrane buttons, representing functions that toggle back and forth between menu options and increase/decrease.

Resident fonts are nothing special, comprising the default draft typeface and an NLQ typeface similar to Courier. Of course, you get several pitch sizes and spacing options. The slot for the optional, \$40 font cards that C-Tech offers is located directly beneath the control cluster, a sensible and accessible spot. Unfortunately, the power switch is located directly beneath the paper thickness lever. It's quite conceivable that you could inadvertently shut the power off while reaching to move the lever. We did.

Reasonably fast performance, attractive text, a generous 32K buffer, an LCD display panel, the ability to handle thick stock and five-part forms, and Star Trek styling: what more could one ask of these printers? Not much. Load either of these

machines with fanfold paper or set up the optional, \$240 single-bin cut-sheet feeder, and operation is essentially carefree. Neither will astound you with its speed, but both offer solid construction, ease of use, and no-hassle printing. And if color figures into your plans on a part-time basis, the C-610C Plus is definitely worth the extra \$60. While both models may seem a bit pricey, a good discount somewhere might make these your favorite new printers.

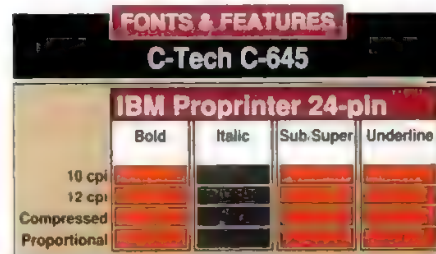
C-Tech C-645

by Ron Goldberg

The C-Tech C-645 is a bit of an aberration in the C-Tech line. Positioned in the gray area between C-Tech's target market and that of CIE America, another of the three C. Itoh diversified companies, the 28-pin printer prices itself out of the single-user market but doesn't pack quite enough punch to be an appealing choice for multi-user duty. Add the availability of low-cost laser printers to the equation, and this \$1,395, flat-bed printer makes sense only for narrow applications, such as moderate-volume printing of multipart forms.

The C-645 uses the same straight-through paper path as the C-610 Plus but accepts paper at width of up to 16.5 inches. As with the C-610 Plus, this design takes some getting used to. Your copy comes out head first and face up, so getting a look at it as it comes out can be difficult. And, while the straight-through path eliminates several opportunities for a paper jam, it requires you to bend far over the top of the printer to load more fanfold paper.

The ergonomic failures of this type of



design run deeper in this printer than in the C-610 Plus, primarily because of this model's opaque cover. Like the C-610 Plus, this unit offers a zero-inch tear bar, but in order to properly set the top-of-form to the correct spot with the C-645, you must open the front cover. This might not be such a big problem were it not for one especially annoying design fault: simply put,



C-Tech C-645

C-Tech Electronics Inc., 2515 McCabe Way,
P.O. Box 25138, Irvine, CA 92714-6297; (800)
877-8445; (714) 833-8445.

List Price: \$1,395

Standard Warranty: One year on parts and
labor

Dimensions (HWD): 23.9 x 13.8 x 8.3 in.
Weight: 33.1 lbs.

Emulations: Epson FX, IBM Proprinter.

In Short: This flat-bed, 28-pin machine handles a
variety of paper in widths up to 16.5 inches.
Though fast, capable, and solid, this printer
makes sense only for certain applications, such
as printing multipart forms.

CIRCLE 631 ON READER SERVICE CARD

we found absolutely no way to open the cover far enough without the entire apparatus falling off. Mounting the ribbon offered more of the same frustration.

Once up and running, however, the C-645 proved a speedy performer. In the default IBM Proprinter emulation, the printer clocked in at 168 cps in draft mode and more than 65 cps in NLQ. NLQ printing was acceptably clear, but we've seen much better results on printers priced at a fraction of the cost. Obviously, the C-645 was built for strength, not elegance. Resident NLQ fonts include Sans Serif, Roman, Courier, and Letter Gothic in a number of pitch sizes and spacings.

The C-645 also offered good graphics speed in its default IBM Proprinter emulation. The machine printed our graphics samples at a rate of 1.5 gppm, a respectable showing. Graphics quality was above average but not spectacular; nicely graded but a bit on the coarse side.

Like the C-610 Plus, the C-645 accommodates multipart forms with as many as five parts, accepts single sheets through the front tray, and—in theory, at least—accepts an optional cut-sheet feeder and optional font cards. Unfortunately, C-Tech reported that none of these options was available yet, nor have they been priced. The machine comes standard with a 32K buffer.

The asking price for this machine is a bit steep considering the competition.

PRINTERS

DOT MATRIX

Then again, C-Tech seems to be carrying on C. Itoh's commitment to solid construction, despite our problems with the aforementioned front cover. If you need a printer capable of turning out multipart or fanfold forms at better-than-average speeds, give this printer a closer look.

Dataproducts 9030

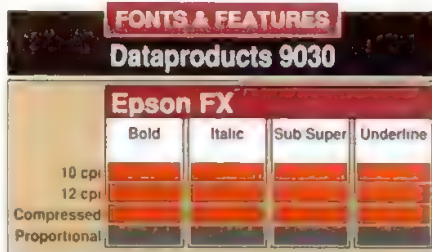
by Joseph F. Rizzo

At \$649, the Dataproducts 9030 is a solid, basic printer. It emulates the Epson FX and the 9-pin IBM Proprinter. During PC Labs' text speed tests, it produced good letter-quality output at 34 cps; draft mode came in at 136 cps. The graphics output, as good as a 9-pin head can produce, tested at a fairly fast 1.3 gppm.

The 9030 offers both rear and bottom paper-loading, which can be especially useful if you intend to print forms, such as checks or invoices. Also useful in the 9030's ability to print 4-ply forms. You can purchase an optional single-bin cut sheet feeder for \$249 and an add-on second bin for \$180. Each bin has a paper capacity of 250 sheets. Also, you can keep your pin-feed (continuous-form) paper in the printer since it does have a two-step procedure for paper parking.

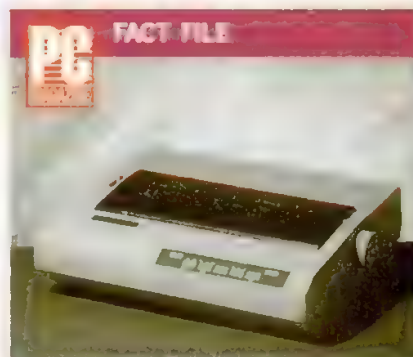
The 9030 has six additional font cartridges available from Dataproducts for a list price of \$75 each.

The printer was easy to set up and use.



The simple process consisted of removing a piece of cardboard, dropping in the ribbon cartridge, plugging in the power cord, and connecting your own printer cable (Centronics is standard; however, the 9030 can be ordered with a serial connection instead). After that, turn it on and you're ready to print.

One design drawback was that the top covers (there are three sections) were not hinged. This meant that every time I had to lift the cover, I had to either hold it in my



Dataproducts 9030

Dataproducts Corp., 6200 Canoga Ave,
Woodlawn Hills, Ca. 91367-2499; (818) 888-
4071.

List Price: \$649; upgrade to 8K, \$50; upgrade
32K, \$100; font cards, \$75; single-bin cut-sheet
feeder, \$249; second bin, \$180; serial I/O kit, \$99

Standard Warranty: One year on parts and
labor.

Dimensions (HWD): 5.2 x 17.2 x 14.3 in
Weight: 21 lbs.

Emulations: Epson FX, Epson EX, IBM
Proprinter.

In Short: The 9-pin 9030 has rear- as well as
bottom-paper-loading features. LQ mode is nice
and graphics output is as good as a 9-pin dot
matrix printer can produce. It can print on up to a
4-ply form—a good feature for an office that prints
checks or invoices.

CIRCLE 632 ON READER SERVICE CARD

hand or find a place to put it down in order to have both hands free. The necessity to remove it arises because the top cover is smoked, making it difficult to see if the paper is lined up at the top of the form.

The manual is easy to read and has enough illustrations and charts to walk you through each procedure. The Dataproducts 9030 is a nice, high-end dot matrix printer that combines good-quality text output with fairly fast graphics.

Dataproducts 9044

by Joseph F. Rizzo

The Dataproducts 9044 is a wide-carriage, color-capable dot matrix printer that costs \$1,199 and emulates the Epson LQ and the Diablo 630. The quality of the color was impressive: The 9044 uses a four-color fabric ribbon and produces very nice graphics. Although it tested at only 0.3 gppm in graphics mode, the results this unit produced were worth waiting for. And even though the head system is designed for a color ribbon, the Model 9044 works equally well with a simple black ribbon. On PC Labs' tests, the draft-quality speed for text was 104 cps; letter quality was 57 cps. The standard Epson LQ fonts all pro-



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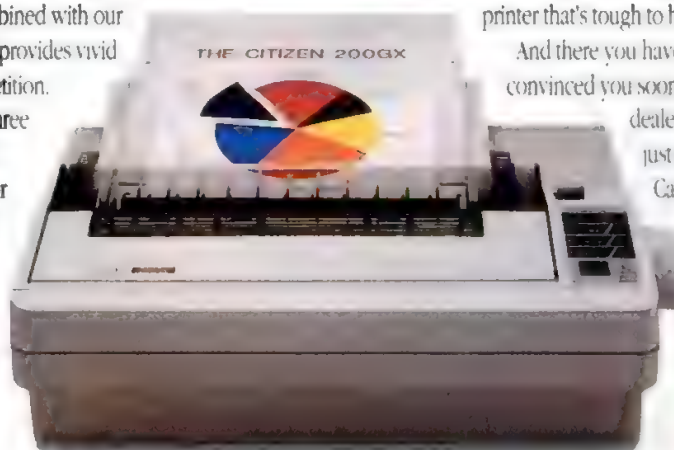
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- 40Mb with 28ms average access time
- Slimline space saving case
- One parallel and two serial ports
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- 14" high resolution Mono VGA monitor
- MS DOS 4.01 and FCC class B certified

System with color VGA (640 x 480) **\$1399**

Note: This system does not include Windows 3.0. Although a 286 can run this software we recommend a 386SX or beyond for efficient Windows 3.0 performance.
CIRCLE 134 ON READER SERVICE CARD

duced good output.

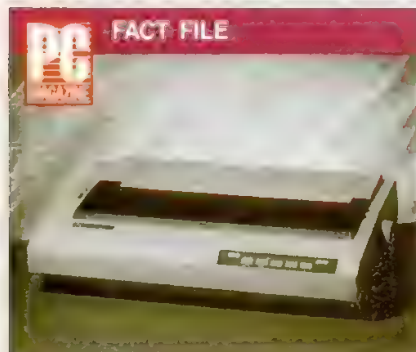
The 9044 can print up to three-ply forms. You can purchase an optional single-bin cut-sheet feeder for \$299 that holds up to 250 sheets, and then you can add a second 250-sheet bin for \$180 to make it dual-bin. And since the 9044 has a two-step procedure for paper parking, you can still keep your pin-feed (continuous-form)

DATAPRODUCTS 9044				
Epson LQ				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

paper in the printer.

The 9044 has six additional font cartridges available from Dataproducts for a list price of \$75 each.

Setup was easy: It consisted simply of removing a piece of cardboard, dropping in the ribbon cartridge, plugging in the power cord, then connecting your own printer cable—either a Centronics parallel or a 25-pin serial cable. Then turn it on and you're ready to print. Another easy-to-use and well-documented procedure lets you select parallel or serial I/O and set other defaults, such as draft mode, paper width and length, and so on through the parameter menu.



Dataproducts 9044

Dataproducts Corp., 6200 Canoga Ave., Woodlawn Hills, CA. 91365-0746; (818) 888-4071.

List Price: \$1,199; font cards, \$75; single-bin sheet feeder, \$299; second paper bin, \$180.
Standard Warranty: One year on parts and labor.

Dimensions (HWD): 5.3 x 23 x 14.3 in.
Weight: 21 lbs.

Emulations: Epson LQ, Diablo 630

In Short: Easy to setup and operate, the wide-carriage, 24-pin 9044 offers very good color output and high-quality LQ text.

CIRCLE 633 ON READER SERVICE CARD

PRINTERS

DOT MATRIX

The 9044 is similar to the 9030 (also reviewed in this issue) except that the 9044 is color-capable and has a wide carriage. However, the two machines are not corresponding versions of each other. Dataproducts also makes the 9040, which is a wide-carriage version of the 9030, as well as the 9034, a narrow-carriage version of the 9044. Neither one of these versions is reviewed in this issue.

The 9044, however, suffers from the same drawback as the 9030 when it comes to the top covers. The three-part covers are smoke-tinted, which makes it difficult to see paper alignment at the top of the form. And in addition, their nonhinged design makes removing and handling them awkward.

The manual is easy to read and has enough illustrations and charts to walk you through each procedure. Overall, the Dataproducts 9044 is a good-quality color dot matrix printer.

DEC LA70 Personal Printer

by Bruce Brown

Digital Equipment Corp. makes and sells fine dot matrix printers, and the \$499 DEC LA 70 Personal Printer is no exception. Like the other printers in the LA line, this 9-pin, narrow-carriage model comes with emulations and connectors that let it get it along with both DEC and PC-compatible systems. Unfortunately, the LA 70 also shares a common problem of most DEC printers: in light of the many other printers available for the PC, it simply doesn't offer compelling performance or price to companies that use PC-compatible computers only.

The 16-pound LA 70 doesn't take up a lot of room, measuring just 4.5- by 16- by 11.5 (HWD) inches. The printer includes both parallel and serial ports, along with a special adapter and cable for serial RS-423 DECconnect interfaces.

DEC rates the LA 70 at 200 cps in high-speed draft mode; maximum printing resolution is 180- by 144-dpi. The standard (and only available) emulations are DEC ANSI and 9-pin IBM Proprinter.

On our speed tests the LA 70 came in at 105 cps in draft mode and 31 cps in NLQ mode. The NLQ type looks fine for 9-pin dot matrix output but looks, alas, like 9-

pin dot-matrix output. An in-between mode called "memo" mode produces middling-quality output at middling print speed.

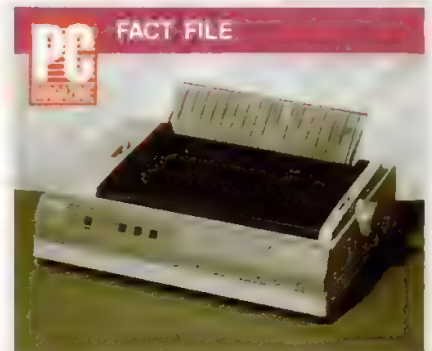
The LA 70 printed our graphics speed test at a rate of 1.0 gppm and again generated output that looks no better than the low-end dot matrix output that it is. Digital rates the LA 70 at a duty cycle of 500 pages

DEC LA 70 Personal Printer				
IBM Proprinter 9-pin				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

per month.

The only font available with the LA 70 is the standard Courier 10, though you can adjust the horizontal pitch in 12 steps from 5 characters per inch to 18 cpi. The feature set in IBM Proprinter mode matches the original, including proportional print but no italics.

The LA 70 can handle paper to a maximum width of 10 inches and can use either friction feed for single pages or built-in tractors for continuous-feed paper. Maximum acceptable paper weight is 24-pound bond. Convenient paper-handling features include two-step paper parking, almost



DEC LA 70 Personal Printer

Digital Equipment Corp., 146 Main St., Maynard, MA 01754; (800) 344-4825, (508) 493-5111.

List Price: \$499; IBM/Centronics parallel cable, \$34; desktop acoustic cover, \$145; desk stand and paper catcher, \$45.

Standard Warranty: One year on parts and labor

Dimensions (HWD): 4.5 x 16 x 11.5 in.
Weight: 16 lbs.

Emulations: IBM Proprinter, DEC ANSI.

In Short: The LA 70 Personal Printer is a well-built, narrow-carriage, 9-pin dot matrix printer that makes the most sense in mixed DEC PC environments. Look elsewhere, however, if you simply need a printer for your PC.

CIRCLE 634 ON READER SERVICE CARD

foolproof auto-loading, and a thoughtful viewing feature that advances the paper so that you can read the last few printed lines if printing pauses. When printing resumes, the paper automatically rolls back to pick up at the right place.

The LA 70's control panel has membrane buttons and simple LED indicators. It's easy to use, partly because there aren't many features to control.

The LA 70 takes a harmonica-style ribbon, which Digital sells at \$26 per box of six. It takes about 30 seconds to switch ribbons.

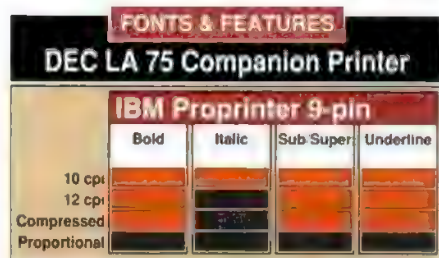
The Digital LA 70 Personal Printer is a sturdy little machine and will do the job it's designed to do: serve as a local workstation utility printer. Those in mixed DEC/PC environments may find this printer to be just what they need. If you're simply looking for a low-end printer for your PC, however, you can easily find a better value elsewhere.

DEC LA 75 Companion Printer

by Bruce Brown

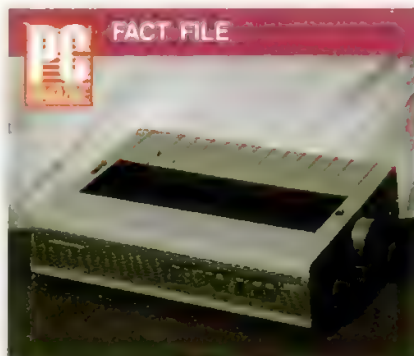
As its name implies, the DEC LA 75 Companion Printer comes one step up from the LA 70 in Digital Equipment Corp.'s dot matrix line. This 9-pin, narrow-carriage model shares the LA 70's DEC ANSI and IBM Proprinter emulations and adds a heavier duty cycle, faster draft printing, an additional letter quality mode, and optional fonts. Unfortunately, in light of the printer's \$835 list price, the added features and increased performance simply don't seem like enough.

The LA 75 is more robust than the LA 70, weighing in at 21 pounds and measur-



ing 5.3- by 17.8- by 13.8 inches (HWD). It also offers a more-flexible paper-handling features and specifications than the LA 70. Though able to handle a maximum paper width of 10 inches and a maximum paper weight of 24 pounds—both the same as on the LA 70—the LA 75

PRINTERS DOT MATRIX



DEC LA 75 Companion Printer

Digital Equipment Corp. 146 Main St., Maynard, MA 01754; (800) 344-4825, (508) 493-5111. List Price: \$835.

Dimensions (HWD): 5.3 x 17.8 x 13.8 in. Standard Warranty: One year on parts and labor.

Weight: 21 lbs.

Emulations: IBM Proprinter, DEC ANSI.

In Short: DEC's 9-pin LA 75 offers a step up in speed and duty cycle from the LA 70 and adds an additional LQ mode. Fine for DEC or mixed DEC/PC offices, not worth its price as a PC-only printer.

CIRCLE 635 ON READER SERVICE CARD

steps up the maximum paper thickness from 0.012 to 0.015 inches. You can also feed paper through the bottom of the LA 75 as well as from the rear. The LA 75 shares the LA 70's convenient auto-loading, paper-parking, and last-lines print viewing features.

The LA 75's control panel uses membrane buttons and single LED indicators. The DEC documentation explains everything clearly, including how to print the setup and configuration menus from the control panel.

The LA 75 uses a clamshell black nylon ribbon rated at 1.1 million characters that Digital sells for \$42 per box of six cartridges. Installing the cartridges is easy and not messy.

The machine is rated at 250 cps in draft mode and 32 cps in letter quality mode. PC Labs benchmark tests clocked the printer at 142 cps and 29 cps, respectively. Duty cycle rating on the LA 75 is 2,000 pages per month, four times DEC's rating for the LA 70.

The draft mode of the LA 75 has the same 12 by 9 print matrix as the LA 70, but the LA 75's best-quality mode jumps up to a 38 by 18 matrix, which creates much sharper text than the LA 70's 24 by 17. The LA 75 still supports the 24 by 17 mode, presumably for those times when you can't live with draft but can't wait for top quality.

The LA 75 clocked in at 1.4 gppm on the graphics speed test in Proprinter mode. While this was not a bad speed, the results were nothing to cheer about: we're still talking about basic 9-pin output.

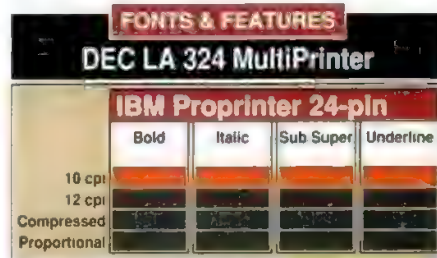
The LA 75's standard font is Courier 10, but you can purchase the Letter Gothic and Orator font cartridges for \$54 each. The feature set in IBM Proprinter mode is faithful to the original, limited Proprinter set, which means you won't get italics.

For mixed DEC/PC environments, the DEC LA 75 Companion Printer may be the perfect buy. It offers a step up from the LA 70 in speed, print quality, and font flexibility. As with the LA 70, however, the LA 75 simply fails to be competitive in a PC-only environment.

DEC LA 324 MultiPrinter

by Bruce Brown

The 24-pin DEC LA 324 MultiPrinter is Digital Equipment Corp.'s premier dot matrix machine for mixed DEC and PC environments. This wide-carriage printer, which uses black or four-color clam-style ribbon cartridges, carries a speed rating of 300 cps and a list price of \$2,095. While its price tag gives one pause, it doesn't seem quite so high if you remind yourself that DEC customers do benefit from sizable discounts based on total purchase amounts, even if DEC doesn't discount individual pieces.



Rated at a duty cycle of 5,000 pages per month, the LA 324 is DEC's idea of a high-volume, heavy-use machine. It weighs but 31.5 pounds and measures 12.5 by 24 by 14.8 inches (HWD). Parallel and serial ports are standard. The LA 324 comes up in a default Digital ANSI mode but includes an IBM Proprinter XL24 emulation as well.

Running in its Proprinter emulation, the machine clocked in at 162 cps in draft mode, a reasonable speed considering its

The Joneses.



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This is especially important in 486 computing, where the CPU performs as many as four times the write operations as in 386. Which makes AMMA's write-back architecture, combined with the 486's embedded cache, a powerful combination indeed.

But the STEP 486 machines give you more than just speed. They come with Programmable Drive Select. If your drive isn't listed on the set-

up table, PDS™ lets you custom-configure the BIOS. It's good for virtually any hard drive.

What's more, all STEP systems come with a one-year extendable warranty and a one year renewable on-site service contract that also covers all Everex peripherals in the system.

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Then you can let the Joneses try keeping up for a change.



300-cps rating. It performed very close to its 100-cps NLQ rating, printing our sample at 83 cps. Text quality was typical of that for 24-pin printers.

Consistent with the longer time it takes 24-pin printers to produce graphics, the LA 324 was slower on our graphics printing speed test than its 9-pin stablemates, the LA 70 and LA 75. The machine printed our graphics sample at a rate of 0.8 gppm. As with text, the results were about what you'd expect from a 24-pin printer, but nothing to rave about. The LA 324 doesn't emulate any PC-compatible color printers, so we were not able to test color graphics printing other than by generating the self-test color bars, which looked fine.

The LA 324 includes only one standard font, a 10-pitch Courier. Optional font cartridges are available for \$89 each and include Letter Gothic, Orator, Prestige Elite, Presentor, and OCR fonts.

The LA 324 can handle 17-inch-wide paper, 24-pound-stock, and 0.02-inch-thick six-part forms. Paper handling is done either through a built-in tractor or friction feed for single sheets. An optional \$795 triple-bin sheet feeder can hold 150 sheets per bin or 300 sheets plus 30 envelopes in the third bin. Paper is fed either from the rear or from the bottom of the printer. Other features are auto-loading, paper parking, and zero tear-off.

A 16-character LCD screen, LED indicators, and several membrane control but-

PRINTERS DOT MATRIX

tons make the LA 324's control panel easy to use.

The DEC LA 324 MultiPrinter is a fine, heavy-duty printer. It's not inexpensive by any means and it's not blazingly fast, but it is built to run without hassles and keep on running. As with the other DEC machines reviewed here, however, there is no compelling reason to buy this printer if you don't use DEC systems.

Epson DFX-8000

by Alfred Poor

While you might not be surprised to find that this heavy-duty 9-pin dot matrix printer weighs in at a hefty 63.9 pounds and carries a hefty sticker price of \$3,699, you might be surprised that it's an Epson.

FONTS & FEATURES Epson DFX-8000				
Epson FX				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

Epson?? That's the company that practically created the personal dot matrix printer market in 1980 with the MX-80 (years before there was an IBM PC) and has continued to create small printers. Not content to rest on its laurels, Epson has decided to attack a new market segment: high-speed data processing printers.

This market used to be the province of large line printers whose speeds are measured in hundreds of lines per minute instead of characters per second. The DFX-8000's list price may seem high, but it's a fraction of what you'd have to pay for a laser printer with this speed. Epson rates the DFX-8000 at 1,066 cps (about 10 times as fast as many inexpensive desktop dot matrix printers), which equals about 275 lines per minute. In our benchmark tests, draft mode yielded about 264 cps, which is better than 10 pages per minute. The printer is only about 40 percent as fast in its best print mode, but at about 138 cps for NLQ it is faster than most desktop units are in draft mode. Even the graphics speed text came in at a fast 1.7 gppm.

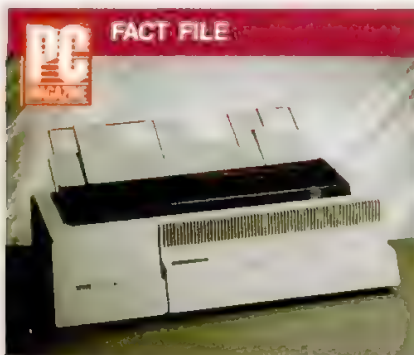
The DFX-8000 is built solidly yet does not look like a piece of industrial machin-

ery. The case has clean lines and fully encloses the printing mechanism. Sound insulation is remarkably effective; you can easily carry on a normal conversation or phone call next to the printer even when it's operating at top speed.

The documentation is typical of Epson quality: excellent. It contains lots of pictures and patient explanations of everything from assembly to the printer commands. The DFX-8000 supports both Epson and IBM Proprinter command sets, making it versatile as well as powerful.

There are two paper paths, front and rear. The paper handling is sophisticated: You can have paper loaded in both sets of tractors, and a single button press will retract the paper from one to park it, then advance the paper from the other tractor. This makes forms changing nearly instantaneous, and indicator lights on the front panel show graphically which paper is loaded. The paper is fed slowly for the first few print lines until it reaches the bail, then the tempo picks up and paper practically shoots out the top slot. Zero tear-off is another feature; there is also an optional tractor feed and even an automatic page cutter that slices up continuous-feed forms as they are printed.

With its resolution of 120 by 72 dpi, you won't buy the DFX-8000 for its print



DEC LA 324 MultiPrinter

Digital Equipment Corp., 146 Main St., Maynard, MA 01754; (800) 344-4825, (508) 493-5111.

List Price: \$2,095; font cartridges, \$88; triple-bin sheet feeder, \$795; IBM Centronics parallel cable, \$34; optional printer stand, \$199; desktop stand, \$68.

Standard Warranty: One year on parts and labor.

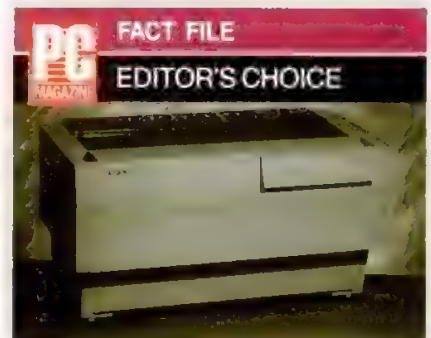
Dimensions (HWD): 12.5 x 24 x 14.8 in.

Weight: 31.5 lbs.

Emulations: IBM Proprinter, DEC ANSI.

In Short: Rugged, fast, and color-capable, the 24-pin LA 324 should prove attractive for use in DEC or mixed DEC/PC environments.

CIRCLE 636 ON READER SERVICE CARD



Epson DFX-8000

Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; (800) 922-8911.

List Price: \$3,699; serial interface with 8K buffer, \$139; serial interface with 32K buffer, \$152; serial interface, \$64; parallel interface with 32K buffer, \$132; parallel cable, \$29; serial cable, \$29; pull tractor, \$149; paper cutter, \$749; DFX printer stand, \$169.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 14.5 x 27.5 x 15 in.

Weight: 63.9 lbs.

Emulations: Epson LQ, IBM Proprinter.

In Short: The DFX-8000 is a high-speed 9-pin printer designed for heavy duty. It has intelligent paper handling but few other frills, and it's fast enough for high volume applications.

CIRCLE 637 ON READER SERVICE CARD

quality, but it performs about as you'd expect for a heavy-duty 9-pin printer. Graphics are a bit dark, but the lines are crisp, and the NLQ text mode is clean though a bit ragged.

From its 400-million-character ribbon to its 11,000-page-per-month recommended duty cycle, this printer is designed for speed and large volume. It is ideal for shared use on a network or for data processing applications where you need to print thousands of pages on a regular basis. Based on the tests of the biggest Epson ever, it looks like the DFX-8000 may repeat the story written by its MX-80 ancestor a decade ago.

Epson LQ-850 and LQ-1050

by Alfred Poor

The LQ-850 and LQ-1050 are arguably two of the best 24-pin printers on the market today, which in part explains why they earned Editor's Choice three years ago. Although the prices for both the narrow- and wide-carriage printers remain about the same (\$749 and \$1,099 respectively), the printers have been improved since their original release. Hence they continue to stay competitive.

One big difference is speed. Epson has developed new code to boost the speed of the printers' controllers. The older versions were rated at 220 cps in draft mode;

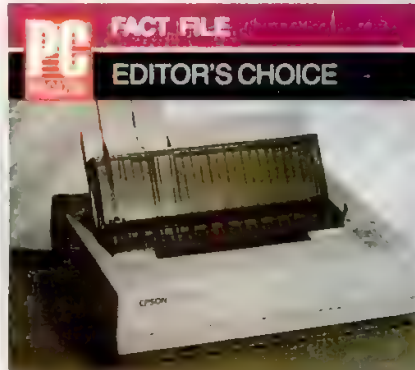
FONTS & FEATURES				
Epson LQ-1050				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

the newer ones, 300 cps—more than one-third faster.

The LQ-850 and LQ-1050 established many of the features in this market that we now take for granted. Since their intelligent paper-handling automatically loads and parks tractor-feed paper, you no longer have to fuss with tractors every time you switch from continuous forms to single sheets. Another feature advances the paper temporarily so you can tear off a form, then retracts it to the starting position.

The front panel offers easy control over

PRINTERS DOT MATRIX



Epson LQ-850
Epson LQ-1050

Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; (800) 922-8911.
List Price: \$749 (LQ-850); \$1,099 (LQ-1050); serial interface board, \$64; serial interface board with 8K buffer, \$139; IEEE488 interface board with 8K buffer, \$139; serial interface with 32K buffer, \$152; parallel interface with 32K buffer, \$132; multifont module, \$99; pull tractor, \$69 (LQ-850); pull tractor, \$84 (LQ-1050); single-bin cut-sheet feeder, \$209 (LQ-850); single-bin cut-sheet feeder, \$269 (LQ-1050); dual-bin cut-sheet feeder, \$329 (LQ-850); dual-bin cut-sheet feeder, \$399 (LQ-1050).

Standard Warranty: Two years on parts and labor.

Dimensions (HWD): 5.6 x 16.8 x 16 in. (LQ-850); 5.6 x 24.7 x 16 in. (LQ-1050).

Weight: 19.8 lbs. (LQ-850); 26.4 lbs. (LQ-1050).

Emulations: Epson LQ.

In Short: What was old is new again, as Epson improves on the established winning design of these two 24-pin printers. Quieter operation, excellent print quality, and more options than ever. These continue to be excellent choices for high-quality dot matrix machines.

CIRCLE 638 ON READER SERVICE CARD

font selection. While many programs offer automatic support for the Epson LQ printer command set, you can also rely on the panel buttons to select between draft and letter quality, between Roman and Sans Serif fonts, normal and condensed type, and between 10-, 12-, 15-pitch or proportional spacing. Indicator LEDs on the front panel clearly mark your selections.

The LQ-850 and LQ-1050 are capable of 360- by 360-dpi resolution for graphics printing. The graphics samples produced in our tests were clear and crisp, though some banding did occur in solid black areas. Text quality is also good: While you won't mistake it for laser output, it should suit all but the most formal requirements. For the very best quality possible, you can replace the 2-million-character fabric ribbon with a 200,000-character film ribbon that gives even better results.

Epson offers other options with these printers, including an external tractor, sin-

gle- and dual-bin cut-sheet feeders that hold 150 sheets per bin, and optional interfaces. A \$99 multifont module lets you add Courier, Prestige, Script, Orator, OCR-A and OCR-B to your bag of tricks.

The printers are well built, with solid construction and good attention to detail. They are well insulated, reducing the potentially obnoxious noise of the dot matrix printhead to comfortable levels. Epson obviously has a great deal of faith in the design and construction quality of these machines: The LQ-850 and LQ-1050 are covered by a two-year parts-and-labor warranty—twice as long as that of the typical competitor.

As a class, dot matrix printers in this price range are under a great deal of pressure from the low-priced lasers and the new and improved ink jet printers. Dot matrix printers still have the upper hand when it comes to printing multipart forms and continuous-feed pages, however, and these two improved printers from Epson continue to be among the best of the bunch.

Epson LQ-860

by Alfred Poor

The Epson LQ-860 is a colorful character. A jack of all trades, this narrow-carriage 24-pin printer can handle just about any type of print job you might send its way. But with a list price of \$949, you pay a premium for its versatility.

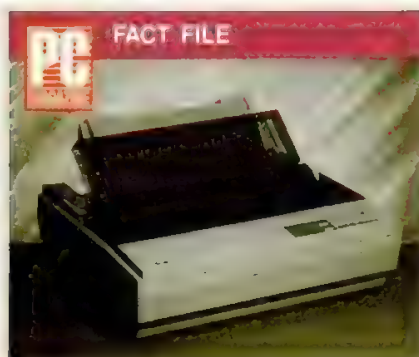
Based on the same 24-pin technology

FONTS & FEATURES				
Epson LQ-860				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

as the LQ-850, the LQ-860 is also rated at 300 cps for draft text. PC Labs text speed tests clocked it at 128 cps for draft and 66 cps for NLQ; graphics text speed was 0.8 gppm. But this printer has an important extra: It can print in color.

Unlike the typical accordion-ribbon cartridge found in most of its Epson stablemates, the LQ-860 has a more-compact clamshell cartridge design. You have your choice of ribbons: a traditional black fabric ribbon, a black film ribbon for higher-

PRINTERS *DOT MATRIX*



Epson LQ-860

Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; (800) 922-8911.

List Price: \$949; serial interface board, \$64; serial interface board with 8K buffer, \$139; serial interface board with 32K buffer, \$152; parallel interface board with 32K buffer, \$132; multi-font module, \$99; single-bin cut-sheet feeder, \$240; pull tractor, \$73; parallel interface cable, \$29; serial interface cable, \$29.

Standard Warranty: Two years on parts and labor.

Dimensions (HWD): 7.5 x 19.6 x 17 in.

Weight: 22 lbs.

Emulations: Epson LQ.

In Short: This color printer gives 24-pin quality with plenty of flexibility, though you pay a premium for all its capabilities. If you need a printer to do a little of everything, this might well be your best choice.

CIRCLE 639 ON READER SERVICE CARD

quality output, or a four-color ribbon that can print the colors of the rainbow. The printer's color output is excellent; our test images showed vivid colors with no problems in registration.

The black fabric ribbon is rated for 3 million characters. The color ribbon is rated somewhat lower, with the yellow band receiving the lowest projected life span: 0.5 million characters. Naturally, the amount and type of color images printed will affect the ribbon's life.

The rest of the printer's features are similar to those of the rest of the LQ family. There are cut-sheet and tractor options and a \$99 multifont cartridge that adds Courier, Prestige, Script, Orator, OCR-A, and OCR-B fonts to the built-in Roman and Sans Serif. Front-panel buttons give easy access to various font and print-enhancement selections, with LED lights to indicate the settings you have chosen. Intelligent paper-handling makes it easy to load tractor-feed paper, then park it so that you can print on single, friction-feed, or cut sheets of paper.

The LQ-850 manual is well written and designed to make it easy to find the information you need. Plentiful pictures and sample printouts help with setup and configuration. As in the manuals for other Ep-

son printers, there is a thorough index in the back, along with a removable cue card that covers switch settings and various printer control commands.

If you need a printer for fast drafts, good NLQ printouts for correspondence, and color capability for charts and graphs, you could buy two or three different printers. Or you could get this one. It costs a bit more than a good black-and-white 24-pin design, but if you need color output and want 24-pin resolution, this unit is worth investigating.

Epson LQ-1010

by Alfred Poor

Some compromises leave you with the best of both worlds; others just miss the mark. Epson's LQ-1010 tries to deliver 24-pin technology in a wide-carriage package for an economy price of \$649, but few are likely to find it a satisfying combination.

The 24-pin LQ-1010 does produce better letter-quality text than most 9-pin machines, but you pay the price in terms of speed. While its graphics test speed of 1.4 gppm placed it in the top half of the field, the LQ-1010 was still only about half as fast as the more expensive LQ-1050. And its draft text speed of about 80 cps was not as fast as the LQ-1050's best-quality print mode speed.

Other corners have been cut on the LQ-

FONTS & FEATURES				
Epson LQ-1010				
Epson LQ				
	Bold	Italic	Sub:Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

1010 to keep costs down. The front panel offers the same controls as the high-end models, and you get the same intelligent paper handling with paper parking and forms tear-off features. Paper-handling is not as rugged, however: The bail and the paper guide are not as sturdy as on the LQ-1050. The LQ-1010's case does not seem to be as well insulated as that of the high-end models either. The printhead sounds were more noticeable during testing.

Documentation for the LQ-1010 is pure



Epson LQ-1010

Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; (800) 922-8911.

List Price: \$649; serial interface board, \$64; serial interface board with 8K buffer, \$139; multifont module, \$99; single-bin cut-sheet feeder, \$219; pull tractor, \$75; parallel cable, \$29; serial cable, \$29.

Standard Warranty: Two years on parts and labor.

Dimensions (HWD): 5.5 x 24.4 x 13.7 in.

Weight: 18 lbs.

Emulations: Epson LQ.

In Short: Flat champagne on a beer budget—the LQ-1010 packages Epson 24-pin technology in a stripped-down case to produce slightly-lower print quality at slower speeds than the more expensive Epson 24-pin printers; you get what you pay for.

CIRCLE 640 ON READER SERVICE CARD

Epson, however. Pictures abound, and the text is easy to understand. After covering setup and commands, the manual even explains how to install the optional cut-sheet feeder, tractor feed, and multifont module.

The LQ-1010 uses the typical Epson accordion-ribbon cartridge, which is rated at 2 million characters. Installation is easy, though you must resort to fingers on the ribbon if you do not succeed in using the pencil-poke method shown in the manual for getting the ribbon into position on the printhead.

The big problem with this printer is its competition. The LQ-1010 does offer a less-expensive entry into 24-pin Epson technology in a wide printer, which may make it appealing for small offices or home use. Still, you need to look hard at the faster alternatives offered by cheaper wide 9-pins or better narrow 24-pins at a similar price before you settle on this one.

Facit B1200

by Ron Goldberg

The Facit B1200 will give you almost everything you could ask for in an entry-level dot matrix printer—and all at a price of \$269. This printer isn't perfect, but one

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doesn't expect perfection from a printer in this price range.

First off, let it be said that the 9-pin B1200 is one of the most attractive printers we saw throughout the printer project. Streamlined and sleek, the B1200's elegant gray casing is accented with mauve casings for the platen knob and friction-feed switch. If there were a beauty contest for printers, we'd have the winner right here, hands down. The 11.1-pound unit is also light enough to tote about the office with ease and even comes with its own built-in handle.

Once past its good looks, you'll see a few features in the B1200 that are uncommon at this price point. For example, the machine offers a quiet mode, which will reduce the noise level by about 3 dB. Unfortunately, it will also lower text speed by a few cps.

You'll also find an effective paper-park function that is activated by two key-strokes on the control panel. The printer accommodates paper as wide as 10 inches and as thick as 0.2 mm, which should enable the printer to handle forms of as many as three parts. Facit will soon offer a single-bin cut-sheet feeder that holds 150 pages, but the company has yet to set the final price. Prices have also yet to be set for the RAM upgrade, which will increase the buffer from 8K to 32K, and the optional telex paper-roll holder.

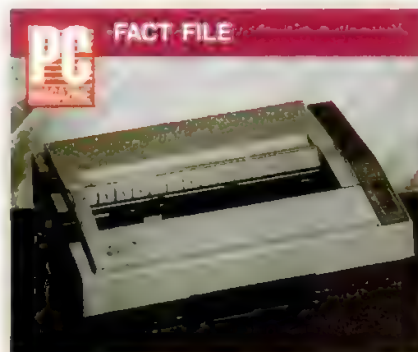
FONTS & FEATURES				
Facit B1200				
IBM Proprinter 9-pin				
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

When it comes to performance, the B1200 delivers very clean text for a printer this inexpensive. Draft text was quite readable, and NLQ printing was dark and well-defined, aided no doubt by the multistrike mylar ribbon.

Though slow when compared with more-expensive 9-pin printers, the B1200 also performs quickly for a printer in this price range. Under both its default IBM Proprinter emulation and its Epson FX emulation, the printer completed our text sample at 74 cps in draft mode and just over 23 cps in NLQ mode. While the NLQ speed is close to the norm for printers in this price range, the draft speed rates above average.

PRINTERS

DOT MATRIX



Facit B1200

Facit Inc., University Center, 400 Commercial St.
PO Box 9540, Manchester, NH 03108-9540;
(800) 73-FACIT, (603) 647-2700.
List Price: \$269; font cards, \$69.
Standard Warranty: One year parts and labor.
Dimensions (HWD): 4.6 x 15.8 x 10.9 in.
Weight: 10.8 lbs.
Emulations: Epson FX, IBM Proprinter.
In Short: The B1200's good looks, solid feature assortment, and crisp NLQ output make it a strong contender at the low-end of the 9-pin scale.

CIRCLE 641 ON READER SERVICE CARD

The B1200 completed our graphics sample at a rate of 0.8 gppm. Again, though slow compared with test results for more-expensive 9-pin printers, this is a respectable showing for a \$269 printer.

On the negative side, reconfiguring the printer for the Epson emulation and other particulars requires setting a bank of tiny DIP switches. Since the switches are located underneath a plastic shield that is somewhat difficult to slide out of the way, this is a finicky task.

Also, don't expect much in the way of typefaces here. The printer comes only with variations of a Courier-like typeface and does not include a proportional font. Facit offers no additional fonts via card or cartridge.

The Facit B1200 has a lot going for it—namely its good looks, crisp NLQ text, low price, and fairly good assortment of features. Its speed is also in line with what you'd expect for a printer in this price range. If you can live with its basic font capabilities, this may be the low-end printer you've been looking for.

Facit B3450

by Ron Goldberg

The 24-pin Facit B3450 shows off the elegant visual design emblematic of Facit's offerings, but the real beauty of this printer

is more than skin deep. In terms of performance, construction, flexibility, and ease of operation, this wide-carriage \$1,249 printer is a gem.

Although the design appears streamlined, the B3450 covers a considerable footprint: 23.8 inches wide by 13.5 inches deep. Printer construction is obviously heavy-duty, with metal replacing plastic for a lot of key machinery. The ribbon and printhead are enclosed within the printer by two closing doors, a nice touch that helps keep the noise level down. Further peace and quiet can be had at a level of 5 dB by turning on the quiet mode. Connections are handled by either a Centronics parallel or an RS-232 serial port.

The B3450 emulates the IBM Proprinter XL, Epson LQ 2500, and Diablo 630. Resident NLQ typefaces include Courier and Letter Gothic, which are available in numerous character pitches and spacings, as well as a proportional font. Facit offers 14 additional typefaces, one per card, at \$69 per card. Internal memory stands at 12K—adequate for most jobs.

Facit seems to have put quite a bit of thought into printer controls. Two groups

FONTS & FEATURES				
Facit B3450				
Epson LQ				
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

of raised buttons lie at the top left of the printer under a plastic cover. This not only looks nice but also keeps you from accidentally pushing the wrong button at the wrong time. The buttons allow you to access specific configuration menus directly, without having to scroll through the entire setup procedure each time you want to change a parameter.

As another nice and unusual touch, a rotary dial on the control panel allows you to choose the character pitch and print mode—draft or NLQ—manually. When the dial is set to a given pitch and quality, the printer will override software font commands. When the dial is set to its center, detent position, the printer relinquishes control to the software.

The B3450 boasts a full assortment of paper-handling features. Continuous forms can be loaded through a bottom-feed straight path as well as through the tradi-

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- High resolution mouse

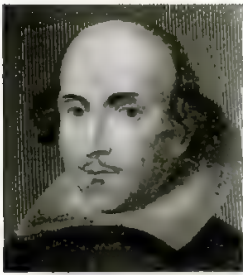
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ProWriter C-610+ 24-pin document printer



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ProWriter C-645 28-pin document printer

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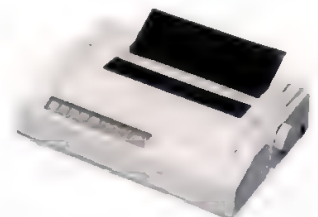
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CIRCLE 500 ON READER SERVICE CARD

PRINTERS

DOT MATRIX

tional rear, U-fold path. The internal tractors tilt to make paper load smoothly, another of the thoughtful features the Facit design team built into this machine. Single sheets are guided by a pair of pop-up arms that fold out of the way when not in use.

Of course, paper parking—activated by the push of a single button—and a zero-tear-off feature are standard. The company offers optional single- and dual-bin cut-sheet feeders at \$309 and \$548, respectively. Paper capacity is rated at 150 pages per bin. The B3450's wide carriage handles paper as wide as 16.3 inches, and the printer will accommodate multipart forms up to four layers, and handle paper as thick as .013 inches.

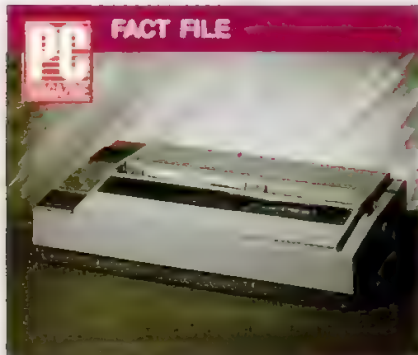
Facit now sells all of its B3000-line computers with built-in color capability,

capabilities figure heavily into your plans, the B3450 can handle the job.

In text mode, you can take your pick of emulations: Both the IBM and Epson emulations performed admirably. Text speed isn't a record breaker, but then again, the Facit is more a Volvo than a Ferrari. In the Epson emulation, the printer rolled out 134 cps in draft and 62 cps in NLQ mode. Print resolution was fine in both draft and NLQ modes, although neither will make you forget your laser printer.

Our only real complaint with this printer concerns its documentation, which offers pictures instead of text to guide you along. Although these illustrations are quite clear, Facit assumes that you pretty much know what you're doing when it comes to installation and paper loading. An inexperienced user might appreciate a few words of explanation to help out with these key procedures.

The Facit B3450 isn't cheap, but the Volvo analogy holds up well: You're buying something built to last a long time. If your business requires a 24-pin dot-matrix printer that requires little attention, you could do a lot worse than the B3450.



Facit B3450

Facit Inc. University Center, 400 Commercial St.
PO Box 9540, Manchester, NH 03108-9540
(800) 733-2248, (603) 647-2700.

List Price: \$1,249; font cards, \$69; single-bin feeder, \$309; dual-bin feeder, \$548

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 5.7 x 24.3 x 15.8 in.
Weight: 33 lbs.

Emulations: Epson LQ 2500, IBM Proprinter, Diablo 630

In Short: This 24-pin, wide-carriage machine prints color with the addition of only a color ribbon and offers elegant styling, heavy-duty construction, high-quality output and a wealth of thoughtful features.

CIRCLE 642 ON READER SERVICE CARD

including the B3450 and its 9-pin counterpart, the \$979 B3150 (see the Printer Blockbuster Issue November 10, 1987). To print in color, you simply snap in the \$26.50 color ribbon and change the setup information. Black ribbons, with a media life of 10 million characters, are \$18.

Once the printer was up and running, we were impressed with the quality of both its graphics and text output. In the color Epson LQ emulation, speed and quality were solid: an exceptionally sharp image printed at a rate of 0.6 gppm. If graphics

play operating scheme.

The Fortis DM3215 offers a full assortment of paper-handling features, including zero tear-off and paper parking, and accepts paper as wide as 17 inches. Continuous forms feed through either the U-fold path at the rear or the vertical path at the bottom. Fortis rates maximum forms thickness at three parts and maximum paper thickness at .016 inches.

FONTS & FEATURES				
Fortis DM3215				
Epson FX				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

The cut-sheet feeder is optional: a single-bin feeder is available for \$299; for \$229 more, you can attach a second bin. Each bin holds 150 sheets.

Our only complaint concerns the automatic paper loading. The first time you send a print job after each power-up, the printer initiates paper loading whether the paper is already loaded correctly or not. This might not be a problem if the printer were smart enough to hold off the print job until it had finished, but it goes about lifting the bale from the paper, sensing the position of the paper, and then lowering the bale while it is busy printing. With text jobs, this won't cause any noticeable problems. With graphics, however, the slight shift in paper position caused by lifting and lowering the bale creates registration problems toward the top of the page. According to Fortis, the only way around this problem is to issue a form-feed before your first print job after each power-up.

During PC Labs' benchmark tests, the performance of our evaluation unit, which came with the \$99 color option already installed, was solid but unspectacular. In its default Epson emulation, draft speed clocked in at a respectable 125 cps. NLQ mode offered clear, dark text but at the modest rate of 35 cps.

Graphics quality was about what you'd expect from a 9-pin printer. Results were no more exciting with the color ribbon under the Epson EX-800 emulation. Our color graphics test printed at a rate of 0.5 gppm. Color quality was acceptable, but overall image quality suffered somewhat because of a tendency to smudge.

All in all, the Fortis DM3215 offers a few nice features but fails to excel in any

Fortis DM3215

by Ron Goldberg

The \$699 Fortis DM3215 stands at the top of DCS/Fortis Corp.'s line of 9-pin dot matrix printers. A step up in features from the Fortis DM 2215, which earned an Editor's Choice in last year's printer roundup (see the Printer Blockbuster Issue, November 14, 1989), this wide-carriage machine offers a few notable conveniences and options, including a \$99 color upgrade kit. Unfortunately, it also suffers from a drawback.

The good news begins with the printer's friendly interface, which uses dedicated buttons for quick access to nearly all control features. For example, choosing one of the three resident typefaces—Draft, Courier, and Gothic—is simply a matter of hitting the menu button once and cycling through the typefaces with the font button. Additional fonts are available at \$69 per five-font card. Changing the pitch works the same way: You use a dedicated pitch button that ranges from 5 cpi to 20 cpi in Courier. This seemingly obvious feature was a nice and unusual touch in an exem-

PRINTERS DOT MATRIX



Fortis DM3215

DCS-Fortis Corp., 1820 W. 220 St., Suite 220, Torrance, CA 90501; (800) 736-4847, (213) 782-5090.

List Price: \$699, font cards, \$69; single-bin sheet feeder, \$299; add-on dual bin, \$229; color option, \$99

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 14 x 24.5 x 6.8 in.

Weight: 27 lbs.

Emulations: Epson EX, IBM Proprinter.

In Short: This 9-pin printer offers a few notable features but suffers from an annoying paper-handling glitch. Overall performance is solid but unspectacular.

CIRCLE 643 ON READER SERVICE CARD

area but ease of use. If your printer is going to be used by different people for a variety of applications, the DM3215's convenient control panel may come in handy. Otherwise you'll find more compelling printers elsewhere in these pages.

Fujitsu DL4600

by Nathaniel Zelnick

Last year we found Fujitsu's top-of-the-line 24-pin printer, the wide-carriage DL4400, to be a versatile, if expensive, unit that delivered good output (for a review of this printer see the Printer Blockbuster Issue, November 14, 1989). This year Fujitsu's \$1,850 color-capable DL4600 offers the same features and fonts, works with the same options, and has the same size, look, and weight as its predecessor, but is faster and costs about \$450 more. We reviewed the \$1,650 monochrome version, which also costs about \$450 more than the 1989 model.

Like the DL4400, which Fujitsu still markets, the DL4600 offers wide-carriage printing in a well-designed, albeit expensive, package. After you insert the paper into the printer through an easy-to-load track in the back of the unit, it travels in a jam-resistant L-path. An optional tractor pull (\$160) allows you to feed paper

through a bottom slot or through an optional front-feeder (\$80). For \$315 you can add a 160-page sheet-feeder, which can also handle 40 envelopes. If that's not enough, two additional 100-page sheet feeders are available for \$175 each.

You select the DL4600's fonts and features through a convenient three-column membrane keypad on its top panel. By scrolling through its various options you can reconfigure the DL4600 without having to power down the unit. You can save a configuration for later use or create one for a single printing session with one keypress. Another keypress walks you through font options or hardware configurations or shows you the printer's three resident emulations: Fujitsu DPL24C Plus, Epson LQ-2500, and IBM Proprinter XL24. Fujitsu also offers an enhanced Diablo daisy-wheel emulation card, the DPL24D, for \$129, and a DEC LA75 emulation card for \$199.

A new Fujitsu-designed 24-pin print-head, as well as new motors to run both it and the paper-feed, distinguish the DL4600 from last year's DL4400. These improvements increase the overall draft speed to 169 cps—not quite the 50 percent increase the company reports, but still an appreciable difference. In NLQ mode the printer again fell short of Fujitsu's claim, yielding a measured speed of 96 cps compared with the DL4400's clocked speed of 67 cps.

The DL4600 produces text that is clear and crisp in several fonts, among them an extremely readable draft font, a proportional-space bold font, and four NLQ fonts—Courier, Correspondence, Prestige Elite, and Pica. You can also purchase nine font cartridges (13 Bitstream fonts),

FONTS & FEATURES				
Fujitsu DL4600				
Epson LQ				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

which range in price from \$50 to \$145.

The DL4600's new parts also have a favorable impact on graphics printing speed. We saw a speed increase of 0.2 gppm, with the DL4600 completing the PC Labs graphics speed test at a rate of 0.8 gppm and last year's model at a rate of 0.6 gppm.



Fujitsu DL4600

Fujitsu America Inc., 3055 Orchard Dr., San Jose, CA 95134; (800) 626-4686, (408) 432-1300.

List Price: \$1,650; color version, \$1,850; font cards, \$50-\$145; emulation cards, \$129-\$199; single-bin cut-sheet feeder, \$315; double-bin attachment, \$175; triple-bin attachment, \$175; pull tractor for use with bottom feed slot, \$160; front feed stand, \$80.

Dimensions (HWD): (HWD) 9.5 x 22.5 x 18.8 in.

Weight: 39.7 lbs.

Emulations: Epson LQ, IBM Proprinter, Fujitsu DPL24C Plus

In Short: Fujitsu's 24-pin wide-carriage dot matrix printer is versatile, well-designed, and easy to operate. It produces very good output quickly, but has a major drawback in price.

CIRCLE 644 ON READER SERVICE CARD

Unfortunately, faster speed didn't always mean perfect graphics. Under both its own Fujitsu DPL24C Plus and Epson LQ-2500 emulations, the DL4600 produced respectable curves and created pleasing contrasts in our gray-scale image test. Under IBM Proprinter XL24 emulation, the printer's output was disappointing. Our test curve was jagged, and our scanned-photo image was compressed and almost uniformly dark. Last year we noted that the DL4400 shortened the same test image under Proprinter 24-pin emulation, but printed it correctly in Epson mode.

For the things it does well—text and forms printing—the Fujitsu DL4600 provides respectable speed, ample resident fonts, and good paper-handling capabilities. Whether the increase in speed it offers over the nearly identical but less expensive DL4400 is worth the premium depends on your applications.

Genicom 3840

by Karen Best

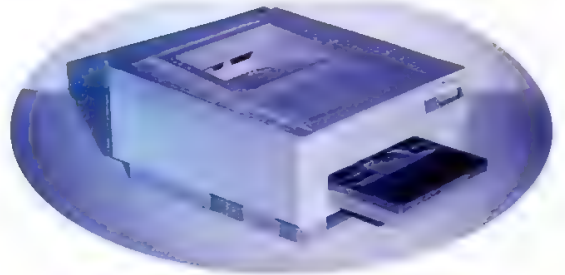
When we reviewed Genicom Corp.'s 18-pin 3820 dot matrix printer last year, we applauded the wide-carriage unit for its speed, paper-handling capabilities, and crisp NLQ text output, and also noted that

CONTINUES

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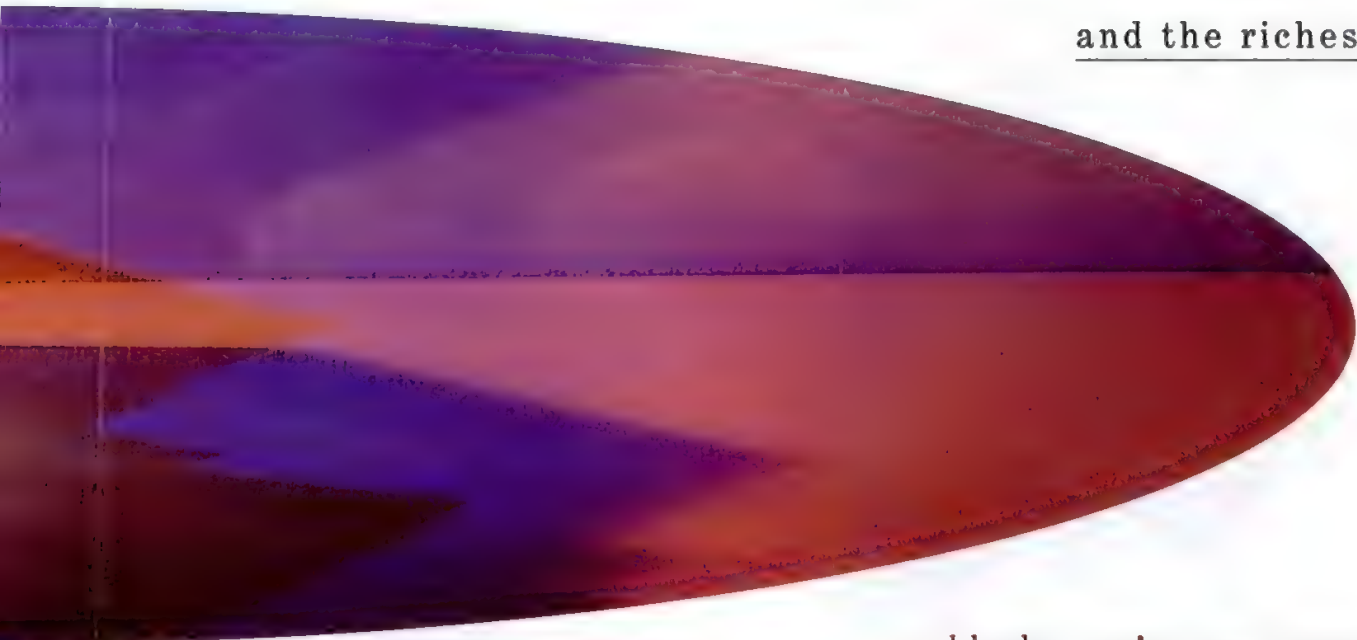
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face[®], the ability to do envelopes,

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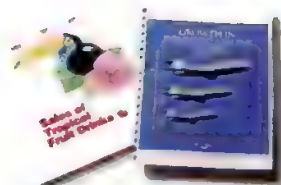
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you'll agree that they should be at
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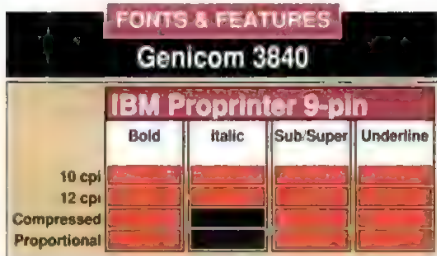
the printer's control panel had an unusually high number of membrane switches and indicator lights. Genicom must have thought so, too, since the control panel of this year's model, the \$2,595 Genicom 3840, has a 16-character LCD and only three LED lights.

Like the 3820, the wide-carriage Genicom 3840 is a heavy-duty 18-pin printer that is strong on paper handling and speed. The 12.1- by 26.9- by 13.9-inch (HWD) printer offers three paper paths, including bottom- and rear-feed paths for continuous forms, and a manual top-feed path for cut sheets or multipart forms. The two paths for continuous forms let the 3840 print alternate forms without your having to unload and reload paper. Automatic paper parking and zero-forms tear-off are also standard.

The 3840 did very well on our speed tests. In its default unidirectional state, the Genicom 3840 printed our test document at a rate of 169 cps in draft mode under IBM Proprinter emulation. In letter-quality mode, we clocked the printer at 105 cps under the same emulation.

These speeds are competitive, but it is only in bidirectional mode that the 3840 really starts to cook. In this state, the 3840 yielded a measured draft speed of 241 cps under Proprinter emulation. Under Epson FX emulation its draft speed was 232 cps and its letter-quality speed was 103 cps.

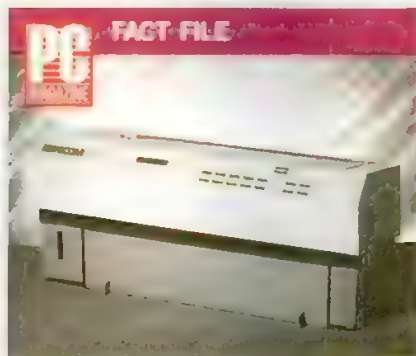
It's obvious that the 3840 is faster in bidirectional mode than it is in its default. Unfortunately, it's not obvious how you change the modes. The manual offers no assistance here. And the printer's control



panel is user-friendly—except in this case. A call to Genicom's technical support staff gave us the answer: deselecting the unidirectional mode will switch the printer into bidirectional mode. To make sure that you've changed modes you'll have to watch the printhead as it moves, since the printer's status report omits this information.

In our graphics speed tests, the 3840 was able to generate our test images at a rate of 1.9 gppm under IBM Proprinter XL

PRINTERS DOT MATRIX



Genicom 3840

Genicom Corp., Genicom Dr., Waynesboro, VA 22980; (800) 4-GENICOM; (703) 949-1000.

List Price: \$2,595; font cartridges, \$100; second tractor set, \$125; pedestal, \$120.

Standard Warranty: One year return to depot.

Dimensions (HWD): 12.1 x 26.9 x 13.9 in.

Weight: 52 lbs.

Emulations: Epson FX, IBM Proprinter, ANSI X3.64.

In Short: A sturdy, high-speed dot matrix printer with excellent paper- and multipart-forms-handling abilities, the 3840 also offers a generous number of resident fonts.

CIRCLE 645 ON READER SERVICE CARD

emulation. Its speed was slower under Epson FX emulation, printing at a rate of 1.0 gppm.

Across the board, the unit delivered good-looking graphics and text in several typestyles, among them Courier, Courier Italic, Gothic, Micro Gothic, Orator, Commercial Script, and Gothic Italic. You can also purchase font cards (\$100 each) for OCR-A, OCR-B, Orator Italic, Prestige, Prestige Italic, Greek Math, and Ball Script typestyles.

Of course, this kind of sturdiness doesn't come cheap. At \$2,595, the Genicom 3840 costs more than many laser printers. But you won't find its excellent paper- and forms-handling capabilities in a laser printer or in many dot matrix printers, either.

Mannesmann Tally 130/9 Mannesmann Tally 131/9

by Ed Perratore

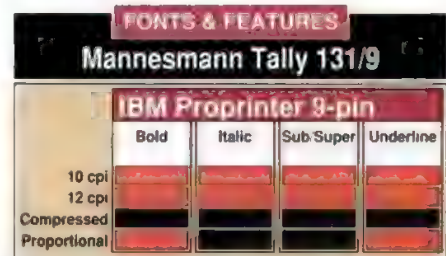
In last year's printer issue we concluded that a number of irritating design decisions marred an otherwise good dot-matrix printer, the 9-pin \$229 Mannesmann Tally 81 (for a review of this printer see the

Printer Blockbuster Issue, November 14, 1989). This year the feature sets of Mannesmann Tally's 9-pin entries, the \$699 narrow-carriage 130/9 and the \$799 wide-carriage 131/9, have tipped the balance in the company's favor.

Identical except for carriage width, the two printers emulate the IBM Proprinter XL, the IBM Graphics Printer, and the Epson FX-105. The 6- by 18- by 13-inch (HWD) 130/9 handles paper up to 10 inches wide and four-part forms that are bound along the top edge. The 6- by 23.3- by 13-inch (HWD) 131/9 also handles multipart forms, but takes paper up to 16 inches wide.

The two printers were fitted with parallel interfaces for our tests; a serial interface is available as well. They both offer 10 cpi and 12 cpi fonts with such enhancements as boldface, italics, sub- and superscripts, and underlining, and a proportional font with such enhancements as boldface and underlining. Not included was a \$119 font card, which you slip into a top slot and install in a receptacle mounted onto the interface board within each model. Card fonts are Kaufmann, Fraktur, and Gothic.

On our graphics speed test, the printers



fared well both in performance and in turning out respectable images. We clocked both printers at 1.1 gppm under IBM Proprinter emulation.

On our text speed tests, the 130/9 yielded a measured speed of 132 cps in draft mode and 44 cps in NLQ mode, somewhat slower than we had expected for a printer rated at 250 cps. The wide-carriage 131/9 yielded measured speeds of 120 cps in draft mode and 43 cps in NLQ mode.

You set emulations, print modes, slashed-zero selection, character densities, languages, and a variety of other options from configuration menus through the printers' control panel. At first glance, you may find Mannesmann Tally's matrix of lights and buttons a bit confusing. If so, don't afix all the blame on the control panel. Instead, fault the documentation, which is clearly written but ponderous thanks to the company's insistence on

PRINTERS *DOT MATRIX*

ers' selection of fonts. Even with their estimated street discount of 30 percent, the 130/9 and 131/9 may face an uphill battle against similarly priced models that offer 24- rather than 9-pin printing, but they are deserving of any attention they get.

Mannesmann Tally 130/24 Mannesmann Tally 131/24

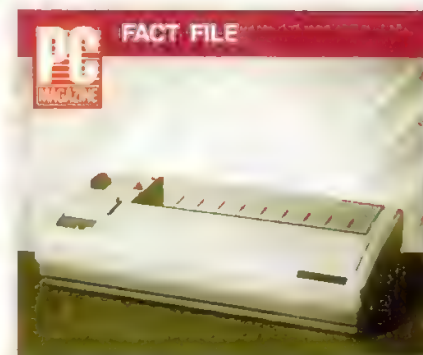
by Ed Perratore

Rounding out this year's group of Mannesmann Tally dot-matrix printers are the narrow-carriage 130/24 and the wide-carriage 131/24, the vendor's 24-pin models. Identical in appearance to the 9-pin 130/9 and 131/9 (see the preceding article for a review of those two printers), the \$899 130/24 and the \$999 131/24 come with a choice of parallel or serial interface; the evaluation units we tested came with a parallel port. The printers' paper-handling options match those of the 9-pin units, as does their sleek control panel. Most important, these models display the same overall attention to detail that makes their siblings worth your consideration.

A few vital details aside from higher price and higher resolution distinguish the company's 24-pin printers from its 9-pin models. For one, the 6.5- by 17.4- by 14-inch (HWD) 130/24 and 6- by 18- by 13-

FONTS & FEATURES				
Mannesmann Tally 131/24				
IBM Proprinter 24-pin				
	Bold	Italic	Sub/Supr	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

inch (HWD) 131/24 offer a greater selection of emulations—ANSI, IBM Proprinter XL and XL24, Epson LQ-2500, and NEC Pinwriter—than the 9-pin units. For another, their performance on the PC Labs graphics tests was slightly slower than that of the 9-pin models. Under the default IBM Proprinter emulation both machines printed our test graphics at a rate of 1.1 gppm. The quality of the printers' graphics is adequate for most purposes, but we did see a few spots that were



Mannesmann Tally 130/24
Mannesmann Tally 131/24
Mannesmann Tally Corp., 8301 S. 180th St., Kent, WA 98032; (800) 843-1347, (206) 251-5524.

List Price: \$899 (130/24); \$999 (131/24); font cards, \$119; color kit, \$269; single-bin sheet feeder, \$169; second-bin attachment, \$129; front-insertion tray, \$29; facedown tray, \$39. **Standard Warranty:** One year on parts and labor, 90 days on-site. **Dimensions (HWD):** 6 x 18 x 13 in. (130/24); 6 x 23.3 x 13 in. (131/24). **Weight:** 24.3 lbs. (130/24); 26.5 (131/24). **Emulations:** Epson LQ, IBM Proprinter, IBM Graphics, NEC Pinwriter. **In Short:** Mannesmann Tally's 24-pin models, to their credit, are similar in features to the vendor's 9-pin units. Improvements in speed and output quality are needed, however, if these machines are to match the best of their 24-pin competition.

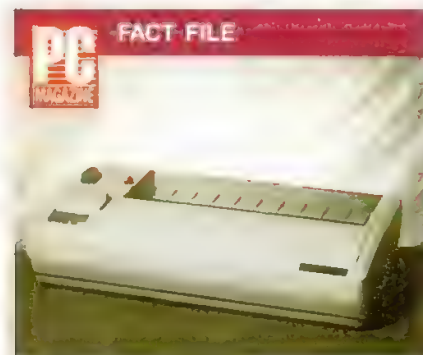
CIRCLE 647 ON READER SERVICE CARD

a bit darker than they should have been.

Under IBM Proprinter emulation in draft mode, the 250-cps-rated 131/24 performed at 127 cps. Under the IBM emulation in draft mode, the 130/24 performed at a speed of just over 128 cps.

The speeds of Mannesmann Tally's 9-pin printers are faster than those of its 24-pin printers, but not by much. And the text print quality of its 24-pin printers is better than that of its 9-pin printers, but not by much. In addition to draft mode, the 130/24 and 131/24 offer letter-quality and near-letter-quality printing; both modes produce exceptional-looking documents. While the printers work with only two \$119 card fonts—Orator and Fraktur are it—their resident fonts include not only draft, NLQ, and LQ in several pitches but also a sans serif typestyle (Gothic) and a script typestyle (Kaufmann) in both NLQ and LQ modes. You select fonts either from the control panel's menu settings or by sending control codes to the printer.

To load continuous-feed paper, you lead it in from the rear of either printer or through a slot beneath it. Cut-sheet paper enters through two guiding brackets, once you've set a menu option and turned the feed-mode knob to the appropriate posi-



Mannesmann Tally 130/9
Mannesmann Tally 131/9
Mannesmann Tally Corp., 8301 S. 180th St., Kent, WA 98032; (800) 843-1347, (206) 251-5524.

List Price: \$699 (130/9); \$799 (131/9); font card, \$119; color kit, \$189; single-bin sheet feeder (130/9), \$169; single-bin sheet feeder (131/9), \$179; second-bin attachment (130/9), \$129; second-bin attachment (131/9), \$139; front-insertion module (130/9), \$29; front-insertion module (131/9), \$34; facedown tray (130/9), \$39; facedown tray (131/9), \$44.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 6 x 18 x 13 in. (130/9); 6 x 23.3 x 13 in. (131/9).

Weight: 24.3 lbs. (130/9); 26.5 lbs. (131/9).

Emulations: Epson FX, IBM Proprinter, IBM Graphics Printer.

In Short: A lot of thought has gone into Mannesmann Tally's 9-pin narrow- and wide-carriage models, demonstrated by their crisp text, speedy output, an intelligently designed menu system. Their pricing, though, may force many buyers to look elsewhere.

CIRCLE 646 ON READER SERVICE CARD

stuffing the 130/9 and 131/9's documentation into one fat book that says every little thing in five languages at a time.

The printers' control panel does have a design flaw all its own: It offers no quick path to on-line status from the "local" setting, from which you issue form- and line-feeds.

Mannesmann Tally dual-bin cut-sheet feeders (\$129 for the 130/9 and \$139 for the 131/9) deserve praise for their precision engineering. Also noteworthy is the way the printer's rear cover can be set in two positions. One is for rear-exit paper travel—you must catch that first page before it rolls up, but it's fine after that. The other position is for easy tear-off. Neither printer wastes any paper, as all paper loaded is printable. But we did find it somewhat difficult to retrieve stray bits of paper that were torn from a misaligned continuous-feed sheet.

It's obvious that a lot of thought has gone into the 130/9 and 131/9 models. Crisp text, decent graphics, good performance, and an impressive menu system are in their favor. More meager is the print-

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PRINTERS

DOT MATRIX

tion. Several paper-handling options are available, too. The two automatic sheet feeder bins (for each model) mentioned in the 9-pin review hold 150 sheets of 20-pound cut-sheet paper; these cost \$169 for the first bin, \$129 for the second, for the 130/24. For the 131/24, it's \$10 more per component. Also available are a \$29 front insertion module and a \$39 facedown module that clips onto the sheet feeder and can hold up to 80 sheets.

Compared with the speed and output you can expect from 24-pin printers these days, the 130/24 and 131/24's offerings fall in the middle of the spectrum. You won't go wrong with these models. But, again, even with a discount of 30 percent, you might find a better bargain elsewhere.

NCR 6417-0101

by Luisa Simone

If you've got a lot to say to the world, high print speed may be an essential feature in the output device you buy. The NCR 6417-0101 is guaranteed to get your words onto paper more quickly than most of its competition. At 167 cps in high-speed draft mode and 163 cps in normal draft, this \$600, 9-pin dot matrix printer burned through the PC Labs benchmark tests. Performance was equally impressive in NLQ mode at nearly 61 cps.

The 6417 takes up a very modest amount of desk space, occupying a footprint of only 15 by 13.5 inches. But small size notwithstanding, this is a very sturdy

sign requires that a full one inch of paper be left blank to accommodate tear-off. NCR rates the printer for use with stock up to 24 pounds and paper as thick as 0.014 inches.

If you intend to use both continuous and cut-sheet paper, be prepared for one minor glitch. Parking the tractor-feed paper always works, but something goes wrong when you use the baler to insert the single sheet into the printer. It will first position itself correctly when you open the baler, exactly as it should. But when you close the baler to begin printing, the piece of paper is immediately ejected. The only solution that NCR's technical staff could suggest requires resetting the top-of-form position after the paper has been ejected, and you must go through this silliness each time you switch from continuous to sheet-fed paper.

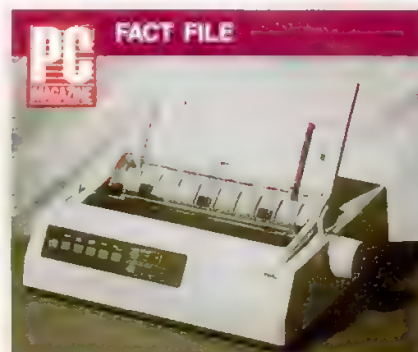
The front control panel contains seven membrane buttons in addition to the paper-park button. The panel's LED indicators make it easy to keep track of current print mode and pitch settings. They also light up whether you issue commands from the front panel or from an application program, so it is possible to see whether the printer is correctly interpreting software codes. You can choose from among high-speed draft, utility (or draft), and near-letter-quality modes. And one button allows you to cycle through pitch settings of 10, 12, 17, and 20 characters per inch or proportional spacing.

Like many of the current crop of dot matrix printers, DIP switches have been replaced by a special setup menu. The NCR 6417 makes access to this menu much simpler by including a Mode button on the front control panel. When you hit the Mode button, the word Menu lights up, letting you know that you can now use the control panel to set any of the printer's functions including the emulation used, bi- or unidirectional printing, line spacing, and type style.

Although the front panel contains no indication of different type styles, careful perusal of the manual revealed that the 6417 offers two different faces for NLQ printing: Courier is supplemented by a sans serif style. In practice, the two faces are actually pretty similar. Though the Courier face is generally more rounded and more pleasing to read, both typefaces have a small x-height (the size of the small letters in relation to the capitals), which

makes the letters look smaller or neater than standard 10 and 12 pitch. If you plan to use both of the typefaces on one page you could further distinguish them by taking advantage of the 6417's many type enhancements, such as, bold, compressed, double wide, and italic formats.

The NCR 6417 uses a resolution of 240 by 72 dpi for graphic images. However, in NLQ mode the vertical resolution is increased to 144 dpi. This makes an enormous difference in the legibility of the type, which is substantially above average. And with a rating of 3 million charac-



NCR 6417-0101

NCR Corp., Peripheral Products Division, 3718 N. Rock Rd., Wichita, KS, 67226-1397; (316) 636-8570.

List Price: \$600; single-bin sheet feeder, \$384; 80-column pull tractor, \$65; 136-column tractor, \$79; serial kit, \$110.

Standard Warranty: 90 days on parts and labor.

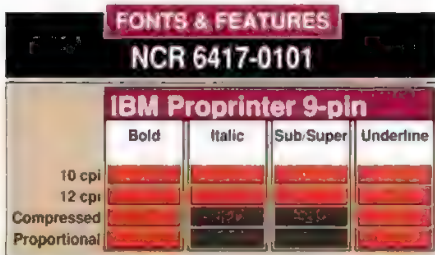
Dimensions (HWD): 5.8 x 15.9 x 16.9 in.

Weight: 18.5 lbs.

Emulations: Epson FX, IBM Proprinter.

In Short: The NCR 6417-0101 is a solid, 9-pin dot matrix printer that offers superior print quality, capable paper-handling features, and flawless emulations. Better-than-average print speed makes this a good value.

CIRCLE 649 ON READER SERVICE CARD



printer. The guide for the cut-sheet feeder fits onto the cover securely, and the paper mechanisms, both sheet-fed and push-tractor, have a nice well-honed feel to them when you turn the platen knob.

The NCR 6417 can accept paper as wide as 10 inches from either the rear or the front of the machine. A lever allows you to adjust the gap between the printhead and the platen for multipart forms, and an automatic paper park function executes at the push of one button. The printer's de-

ters, the Okidata ribbon guarantees that your copy will be crisp and black.

The two emulations offered—IBM Proprinter and Epson FX—functioned flawlessly. In fact, the only problem I encountered—difficulty with a carriage return after double-side characters—proved to be consistent with how a real Proprinter works.

Options for this printer are few and not wholly desirable. There is no way to supplement the 28K buffer that comes with the printer. The only cut-sheet feeder available holds 100 sheets of paper and costs \$384, more than half the price of the printer itself. And if you opt for the \$65 external pull tractor, you'll find that you cannot use the paper-park function.

Positioned as a single-user utility printer, the NCR 6417 delivers two easy-to-

read typefaces, exceptional speed for its price, and abundant paper-handling options. NCR also offers the printer in a wide-carriage version for \$860. If printing your words quickly is more important than printing in a variety of typefaces, either the standard- or wide-carriage version of the NCR 6417-0101 may well be for you.

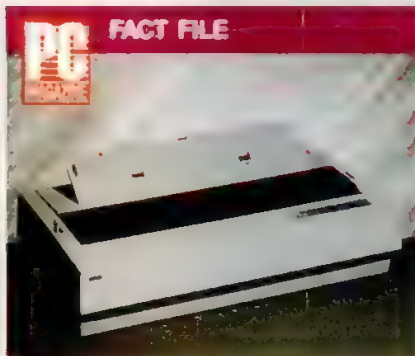
NCR 6421-0201

by Luisa Simone

While most printers compete with one another by adding fonts and features, NCR Corp.'s 6421 dot matrix printer takes a different tack and delivers a solid, no-frills performance. This \$1,050, 9-pin impact printer eschews fancy features and instead stresses standardization and ease of use.

This sturdily built machine has five easy-to-use membrane buttons on the front panel. In normal operating mode these buttons provide basic printer functions, such as switching to letter-quality print or issuing a line feed command. They also obviate the need for DIP switches by providing a special setup menu. The fundamental op-

PRINTERS DOT MATRIX



NCR 6421-0201

NCR Corp., Peripherals Products Division, 3718 N. Rock Rd., Wichita, KS, 67226-1397; (316) 636-8570.

List Price: \$1,050; upgrade to 10K, \$25; single-bin sheet feeder, \$249; second bin, \$159.

Standard Warranty: 90 days on parts and labor.

Dimensions (HWD): 5.5 x 16 x 23 in.

Weight: 26.4 lbs.

Emulations: Epson FX, IBM Proprinter.

In Short: This sturdy 9-pin, wide-carriage, printer generates highly legible Courier typeface, but the lack of paper parking and a low duty cycle make this workhorse unsuitable for heavy loads.

CIRCLE 650 ON READER SERVICE CARD

print 1.2 pages per minute when outputting graphic images.

All of these plain vanilla features would be acceptable—even at a price of over \$1,000—if the 6421 were positioned as a workhorse that churned out high volumes of copy without complaint. And, in fact, the \$11 ribbon is rated for 2 million characters, which seems to hint at that positioning. But with a maximum memory upgrade of only 8K, small cut-sheet bins, and a rather low duty-cycle of 25 percent (which means the company feels the printer will be idle for an average of 6 hours for every 8 hour work day), the 6421 is no Clydesdale. Consider this machine only if ease of installation and operation is your primary concern.

NEC Pinwriter P6200 NEC Pinwriter P6300

by Robin B. Bornstein

Two years ago, the \$799 NEC Pinwriter 5200 earned an Editor's Choice for its quick performance and excellent print quality (see the Printer Blockbuster Issue, October 31, 1988). NEC's latest 24-pin offerings, the NEC Pinwriter P6200 and P6300, fill the same mid-range market position as their predecessor but improve upon speed and features. Both accommo-

FONTS & FEATURES NCR 6421-0201				
IBM Proprinter 9-pin				
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

erating characteristics of the printer—including whether you use the default IBM Proprinter or the alternate Epson FX emulation—must be determined via this menu. Everything else, however, including page size, type quality and pitch, and international character set can be determined by menu choices or software codes.

With a maximum paper width of 15.5 inches, paper weight of 25 pounds, and forms thickness of 0.011 inches, the wide-carriage NCR 6421 can accommodate everything from letterhead to multipart forms. Multipart forms feed through as easily as single sheets, thanks to a gap adjustment lever that lets you set four levels of spacing between the print head and the platen. You can feed paper into the printer through either vertical path at the bottom or the U-fold path at the rear. In addition to friction feed, the NCR 6421 has a movable tractor mechanism that can be positioned

so that the pins either pull or push the paper. One caveat: repositioning the tractor requires a good strong jerk, or the tractor won't lock into position and the paper will misfeed.

Unfortunately, the NCR 6421 falls short on other essential paper-handling features. You can purchase a cut-sheet feeder for \$249, but the single bin holds only 100 sheets. There are no automatic paper parking facilities, although if you clear the continuous-feed paper manually, it won't interfere with sheet-fed printing. And there are no special arrangements to accommodate tear-off: Fully 1 inch of the paper is unprintable if you want to use continuous-feed forms.

Aside from its draft text, the NCR 6421 comes with only one typeface: Courier. The Courier face in NLQ and LQ modes is wonderfully clear, and even in compressed mode the characters do not suffer from ink fill. Enhancements such as proportional spacing make it possible to give the type a slightly more professional look. But despite the LQ label, the 6421's 240- by 72-dpi resolution produces copy that is recognizable as 9-pin output.

The NCR 6421 turned in a very respectable time of about 135 cps in draft mode on the PC Labs benchmark test, but performance dropped considerably when NLQ and LQ modes were engaged: 32 and 29 cps, respectively. You can also expect to

FONTS & FEATURES NEC Pinwriter P6300				
Epson LQ				
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

date NEC's optional, \$119 color kit.

The only notable differences between these two latest models are carriage size and price. While the P6200 lists for \$749 and handles paper as wide as 11 inches, the P6300 lists for \$999 and accommodates a paper width of up to 16 inches.

Setup is easy, due in part to the short installation booklet that accompanies the user's manual. Connection is through a Centronics parallel port or the optional \$119 serial connector. To take full advantage of the features of these printers, you'll probably want to use them in their default, NEC Pinwriter mode, but you'll also find an emulation of the Epson LQ-1500.

Paper handling ranks high on the list of

PRINTERS

DOT MATRIX



PERFORMANCE TESTS: DOT MATRIX PRINTERS

PC Labs finds no direct correlation between print speeds and the number of printhead pins for draft printing, but that 24-pin printers enjoy a speed advantage over 9-pin machines for LQ jobs. If most of your work requires printing draft text, a 9-pin printer may meet your needs; but if most of you require LQ text, a 24-pin printer is the way to go.

The dot matrix printers in this year's roundup are presented here in two categories: 9-pin and 24-pin printers. The 9-pin category also includes 18-pin printers as most of them utilize a 9-pin emulation; and the 24-pin slot includes 28-pin printers which normally use 24-pin emulations.

The fastest serial impact matrix printer is the Epson DFX-8000. Rated at over 500 cps, the DFX-8000 cranked out 324 cps in draft mode for PC Labs' printer tests—outstripping its nearest competitor by 74 cps! It also enjoyed the fastest LQ speed, clocking in at

138 cps. However, it was only 21 cps faster than its nearest competitor in LQ mode, the Bull Compuprint 4/68. The 18-pin printhead of the 4/68 permitted it to make single pass LQ characters where the DFX-8000 had to make two passes.

Following the DFX-8000 were four high-performance 18-pin machines from CIE America, Genicom, Bull, and Texas Instruments. The CIE and Genicom printers achieved 250 cps and 241 cps, respectively, on PC Labs' tests. The Bull and TI printers came in at 192 cps and 174 cps, respectively. The TI printer is noteworthy here because of its built-in 3.6-second delay from the time it starts receiving data to the time it starts printing. As of this writing, TI has no provision to cancel this delay, which significantly slowed down their printer in our tests.

Nevertheless, all of the aforementioned printers were faster than the fastest 24-pin printers in draft mode. The fastest 24-pin unit in draft mode was the Olivetti DM600S, scoring 172 cps on our test. Its margin of victory, however, was a mere 3 cps. In fact, the top six performing 24-pin printers were separated by a mere 10 cps. This indicates that features and price should be greater buying criteria than performance for these printers.

In our graphic speed test, the 9-pin printers generally outperformed their 24-pin counterparts for two reasons. First, the sizes of the graphic files for 9-pin printers are much smaller than those of their 24-pin siblings. Second, the number of pins and the density of the graphics are less for the 9-pin printers than for 24-pin machines.

With the heat generated in the printhead by printing bit-image graphics, duty cycle (the time a printer can print as opposed to the time it must stay idle in order not to completely destroy the printhead) also becomes an important factor in graphics printing times. It therefore comes as no surprise that the fastest printers graphically are the most rugged: the CIE CI-5000, the Genicom 3840, Epson's LQ-850 and LQ-1050 were the four fastest printers overall in our graphics test.

Note that for the most part, there is no direct correlation between print speeds and the number of pins in the printhead for draft printing (i.e. 24-pin printers are not necessarily faster than 9-pin printers or vice versa). However, 24-pin printers enjoy a decided advantage over 9-pin products when printing LQ text, since almost all 9-pin printers require two passes over the same line to produce LQ characters where 24-pin printers require only one pass per line.

CONTINUES

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Warranty	Parts: 2 years Labor: 1 year	Parts: 2 years Labor: 1 year



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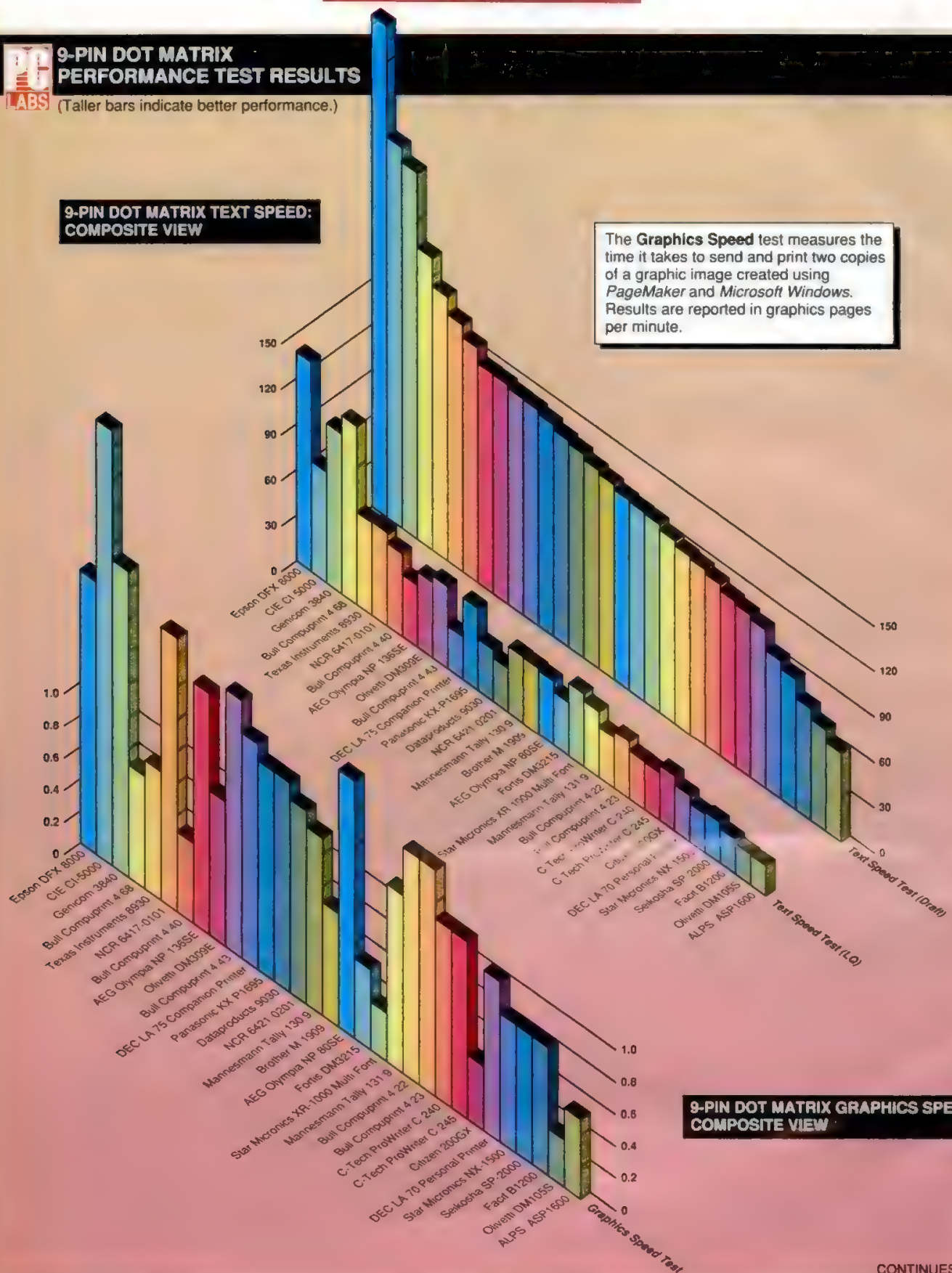


9-PIN DOT MATRIX PERFORMANCE TEST RESULTS

(Taller bars indicate better performance.)

9-PIN DOT MATRIX TEXT SPEED: COMPOSITE VIEW

The **Graphics Speed** test measures the time it takes to send and print two copies of a graphic image created using *PageMaker* and *Microsoft Windows*. Results are reported in graphics pages per minute.



9-PIN DOT MATRIX GRAPHICS SPEED: COMPOSITE VIEW

CONTINUES

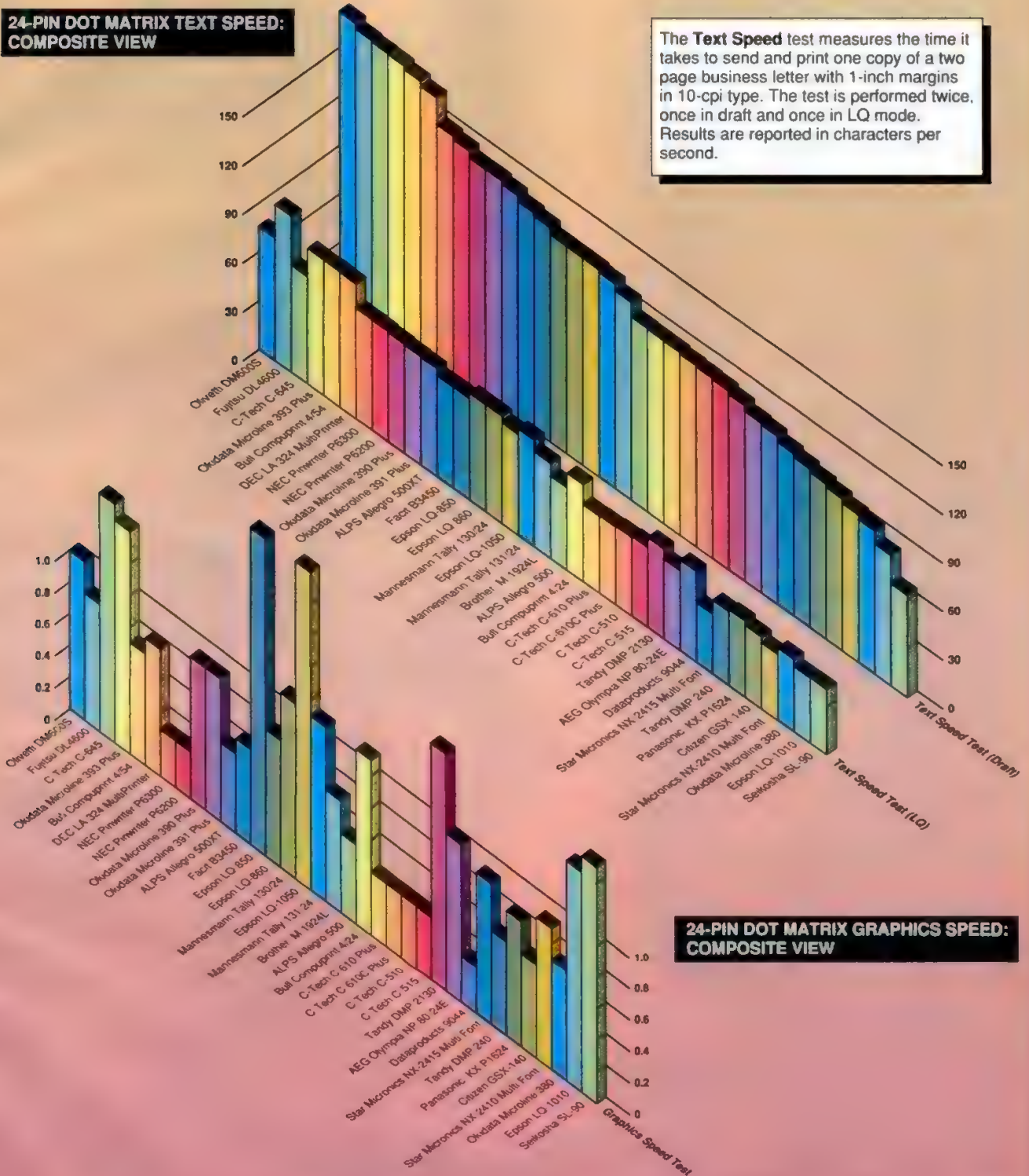


24-PIN DOT MATRIX PERFORMANCE TEST RESULTS

(Taller bars indicate better performance.)

24-PIN DOT MATRIX TEXT SPEED: COMPOSITE VIEW

The **Text Speed** test measures the time it takes to send and print one copy of a two page business letter with 1-inch margins in 10-cpi type. The test is performed twice, once in draft and once in LQ mode. Results are reported in characters per second.



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things these printers do well. The single-sheet feeder and rear push tractor will easily meet the everyday letter- and list-printing needs of most users. For those who need to print on labels, multipart forms, and heavy paper, NEC also offers an optional pull tractor that allows use of the bottom, vertical path. Both printers can accommodate a forms thickness of 0.02 inches and a maximum paper weight of 24 pounds, and both deserve laurels for their flawless handling of three-part forms and heavy card stock during our tests.



FACT FILE

EDITOR'S CHOICE

NEC Pinwriter P6200

NEC Pinwriter P6300

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; (800) 632-4636, (508) 264-8000.

List Price: \$749 (P6200), \$999 (P6300); font cards, \$125; one-bin sheet feeder, \$209 (P6200), \$269 (P6300); two-bin sheet feeder (P6300), \$399; pull tractor, \$149 (P6200), \$169 (P6300); color option, \$119; serial interface, \$119.

Standard Warranty: One year on parts and labor, first 90 days on-site.

Dimensions (HWD): 11 x 19 x 14.8 in. (P6200); 11 x 24.3 x 14.8 in. (P6300).

Weight: 23 lbs. (P6200); 29 lbs. (P6300).

Emulations: Epson LQ, NEC Pinwriter.

In Short: Though providing disappointing color performance, these narrow- and wide-carriage 24-pin printers offer impressive text speed and excel in paper handling and ease of use.

CIRCLE 651 ON READER SERVICE CARD

While NEC built automatic paper parking into the P6200 and P6300, it also built in the ability to disable it. When automatic parking is turned off, you can execute paper parking manually with the push of one control-panel button. The push of another button, Tear Paper, pushes continuous paper for a few seconds so you can tear it, then returns the paper to the original position. Paper-handling options include a single-bin cut-sheet feeder, priced at \$209 for the P6200 and \$269 for the P6300, and a \$399 dual-bin cut-sheet feeder, which is available only for the P6300. Each bin holds as many as 180 pages and can also function as an envelope feeder.

Both printers come with a generous selection of eight resident typefaces, including NEC's Draft Gothic and middling-quality Quick Gothic, which provides better-than-draft text at faster-than-NLQ speeds. Letter-quality typefaces include three monospaced faces—LQ Courier, LQ Prestige Elite, and LQ ITC Souvenir—and three proportional faces—LQ Bold, LQ Times, and LQ Helvetica. Eight additional font cards are available at \$125 apiece and contain two to four fonts per card.

The control panel is straightforward and friendly. Each resident typeface is listed on the panel next to its own LED indicator. To choose from among the typefaces, you simply cycle through the choices by pushing the Type Style membrane button. Another button lets you cycle through available character pitches, which are displayed on a two-digit LCD panel. Interestingly, the panel indicators show the active typeface and pitch even when the software is in control of these settings.

In PC Labs benchmark tests, the printers earned respectable marks with text and consistently generated good, clean output. Tested using the draft Gothic font, the P6200 clocked in at 144 cps and the P6300 at 146 cps. Both printers, as expected, printed at about half that rate in LQ mode, clocking in at 69 cps. LQ text output is clean, and all the characters are fully formed, but the copy isn't so good that you would mistake it for laser output. The printer clocked in at 94 cps when using its Quick Gothic typeface. The resulting characters were well-formed and not as jagged as draft type but were much thinner than standard LQ text.

The optional \$119 cartridge color kit is simple to install. You simply remove the printhead, pop in the color module, and snap on the color cartridge. However, the printers generated our color graphics sample at a disappointing 0.3 gppm. As for quality, the colors were deep and saturated, but the printer tended to smear areas of yellow. On our half-tone graphics image, the printers failed to show enough distinction between different shades of gray. NEC rates maximum resolution at 360 by 360 dpi. Both printers come with a generous 80K buffer.

The NEC Pinwriter P6200 and P6300 excel in paper handling and ease of use. Compared with other 24-pin printers in this price range, they also offer impressive print speed. While those who plan to keep

their dot matrix printers busy with lots of graphics can probably do better elsewhere, both of these printers should appeal to buyers who need a versatile, low-cost workhorse for text and an occasional graphic.

Okidata Microline 380

by Kellyn S. Betts

The sleek, streamlined design of the newest Okidata Microline, the 380, gives it a very modern look, especially when compared with its boxy brethren. This 24-pin printer's aesthetically pleasing shape and low \$449 list price make it notable.

The narrow-carriage 380 is as solidly constructed as prior Microline 80/90 models, but Okidata appears to have approached the design of this model with a heightened concern for ergonomics. The location of the control panel in a recessed area toward the left of the front panel makes it more easily accessible than with other Microline machines. The printer's Centronics parallel connector is cleverly tucked away underneath the body of the printer, so that the interface cable doesn't take up extra space behind the printer.

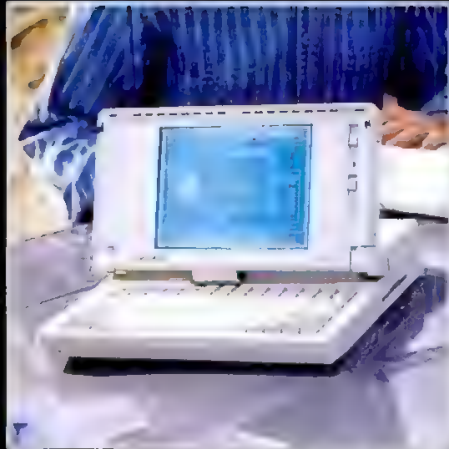
The intelligent design also makes the printer easy to set up. All parts snap to-

FONTS & FEATURES				
Okidata Microline 380				
Epson LQ				
	Bold	Italic	Sub/Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

gether easily and logically, including the optional \$169 single-bin cut-sheet feeder, which holds as many as 50 pages. You get the impression that the printer's designers intended to include the options from the first. The manual does a nice job of describing all facets of setup and operation.

The Microline 380 provides two paths for continuous-feed paper, a rear, U-fold path and a bottom, vertical path. The rear path makes use of the machine's internal tractors, but you'll need the optional, \$59 external tractor feed if you plan to use the bottom path. Single sheets feed through a top, U path. Activating the paper-parking feature requires only one keystroke on the control panel, and the printer includes a

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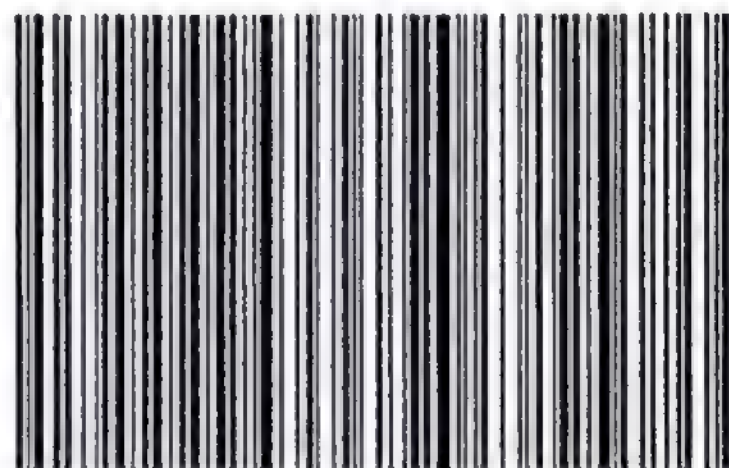
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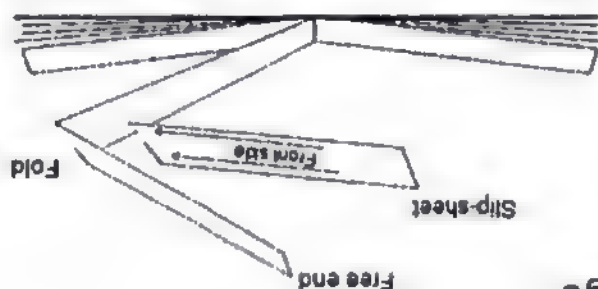
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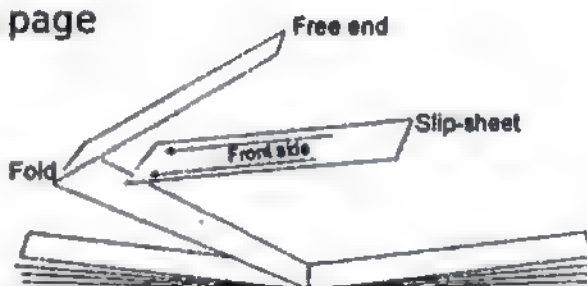
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

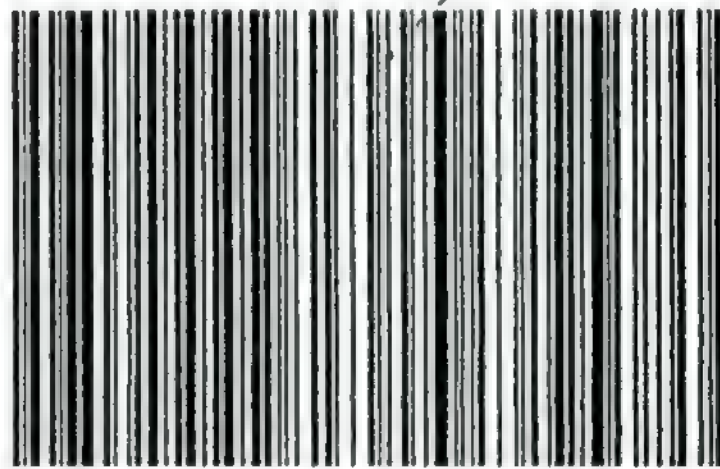
1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Back

0018-0051pback



Inverted Back

1. Follow instructions on the other side

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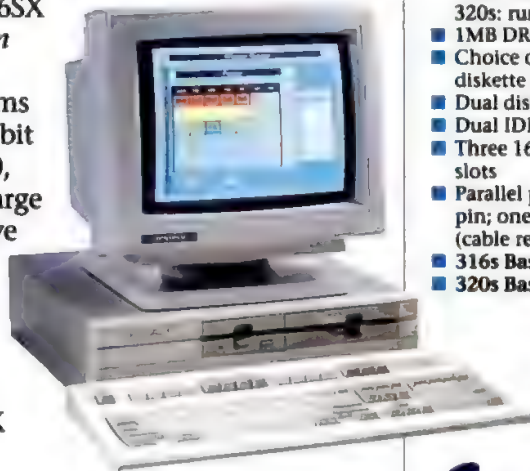
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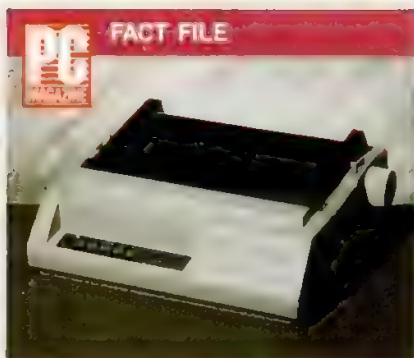
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PRINTERS

DOT MATRIX



Okidata Microline 380

Okidata, 532 Fellowship Rd., Mount Laurel, NJ 08054; (800) 654-3282; (609) 235-2600.

List Price: \$449; single-bin cut-sheet feeder, \$169; pull tractor, \$59; serial interface, \$99.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 8.5 x 14.1 x 19.9 in.

Weight: 17.9 lbs.

Emulations: Epson LQ.

In Short: A well-priced, well-designed printer that produces good-looking output at reasonable speeds. It carries a mercifully low list price that makes it one of the serious contenders at the low-end of the 24-pin market.

CIRCLE 652 ON READER SERVICE CARD

scale bars. The 380 is the only printer in the Microline 300 line that will not emulate an IBM Proprinter.

All things considered, the Microline 380 is a good buy, especially at Okidata's \$310 suggested street price. Its combination of laudable design, impressive text quality, and good graphics abilities make it a formidable contender at the low end of the 24-pin printer spectrum.

Okidata Microline 390 Plus Okidata Microline 391 Plus

by Kellyn S. Betts

The Okidata Microline 390 Plus and 391 Plus still bear the same price tags as their unenhanced versions and still look much the same, but this sturdily crafted duo in the middle of Okidata's 24-pin line does contain some noteworthy improvements.

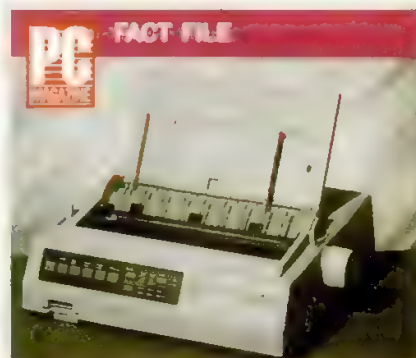
As they did in their previous incarnations, the \$699 narrow-carriage 390 Plus and the \$949 wide-carriage 391 Plus produce extremely sharp character print. The number of resident typefaces in the models has been increased from one to six, however; now Roman, Helvetica, Prestige, Orator, and Letter Gothic are available in addition to Courier. Each is available in

FONTS & FEATURES				
Okidata Microline 391 Plus				
Epson LQ				
	Bold	Italic	Sub:Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

one proportional and five nonproportional sizes from 10 cpi to 20 cpi, with an array of enhancements.

Two years ago, we reported that the 390 and 391 produced smudgy graphics (see the Printer Blockbuster Issue, October 31, 1988). This year, their graphics output is superb, thanks in part to the maximum resolution of 360 by 360 dpi. Okidata reports that new ribbon technology is responsible for the improvement.

And while Okidata reported increasing the throughput—the speed at which the paper is fed through the printer—the draft



Okidata Microline 390 Plus

Okidata Microline 391 Plus

Okidata, 532 Fellowship Rd., Mount Laurel, NJ 08054; (800) 654-3282; (609) 235-2600.

List Price: \$699 (390 Plus); \$949 (391 Plus); upgrade to 40K, \$89; cut-sheet feeder, \$299;

serial interface, \$89; pull tractor, \$55.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 5.9 x 16.1 x 17 in. (390 Plus); 4.6 x 21.7 x 13.6 in. (391 Plus).

Weight: 18.5 lbs. (390 Plus); 22.3 lbs. (391 Plus).

Emulations: Epson LQ, IBM Proprinter.

In Short: These 24-pin printers offer respectable speed, superb print quality and a nice range of features.

CIRCLE 653 ON READER SERVICE CARD

zero tear-off feature. Maximum paper width is 10.5 inches and maximum paper thickness is 0.011 inches. Okidata rates maximum stock weight at 22 pounds for bond and 100 pounds for card stock.

Okidata has standardized its user interface so that the control panel buttons on all models are laid out identically, and the Menu Select mode now operates in the same way on all Microline models. The Menu Select mode has also been notably improved since we reviewed the Microline 172 last year; for example, it no longer wastes paper (see the Printer Blockbuster Issue, November 14, 1989).

In terms of actual printing capabilities, the 380 produces very good-looking characters, especially in its letter-quality mode, and provides a nice selection of resident typefaces: Courier, Gothic, Helvetica, Orator, Prestige, and Roman. Each typeface is available in five pitch sizes and with proportional spacing.

The rest of its printing quality and speed features are less outstanding, however. On our speed tests, it printed draft text at 89 cps and letter-quality text at 45 cps, running in its default, Okidata mode. Its graphics speed was an unimpressive 0.7 gppm in Okidata mode and 0.9 pages per minute when emulating an Epson LQ-2500. The graphics themselves are good, but not great. In both emulations there seems to be a bit of a problem with ink smearing and proper printing of the gray-

print speeds of the 390 Plus and 391 Plus remain comparable to those of the original models, both clocking in at 140 cps. Neither these speeds nor any of the others reported for these two printers were exceptional, but they are certainly respectable.

The rest of the improvements in the 390 Plus and 391 Plus reside on the options list. You now have the ability to switch between continuous forms and cut sheets when the optional \$299 170-sheet capacity sheet-feeder is installed. In previous models, you had to use either one or the other and had to remove the sheet-feeder to print on continuous forms. You'll also find an optional \$89 card that you can use to expand printer memory by 17K to 40K.

The 390 Plus and 391 Plus offer the same paper-handling options found on all of the Microline models: a standard rear-fed U path utilizing the internal push tractor; single-sheet feed through the top of the printer (with an easy-to-use paper-park option); and a bottom-fed path using a pull tractor, which is an \$89 option on these printers. The 390 Plus accepts paper as wide as 10 inches, and the 391 Plus handles paper as wide as 16.5 inches. Okidata rates both models for paper stock of up to 24 pounds and for card stock of up to 100 pounds. Maximum forms thickness is 0.014 inches.

Based on our tests, our two-year-old assessments of these printers stand: they're

still "definitely printers to admire." Based on the knowledge gleaned from our recent survey of user satisfaction with service and support (see Service and Reliability Survey, September 25, 1990), we should add that we hope Okidata's improvements succeed in decreasing the incidence of problems associated with the original models.

Okidata Microline 393 Plus

by Kellyn S. Betts

The Microline 393 Plus appears to be the last of Okidata's tank-like dot matrix printers. Like its 390 Plus and 391 Plus brethren, this big, sturdy \$1,499 printer is a tweaked version of its no-plus predecessor, but this 24-pin model has aged even better than the other two.

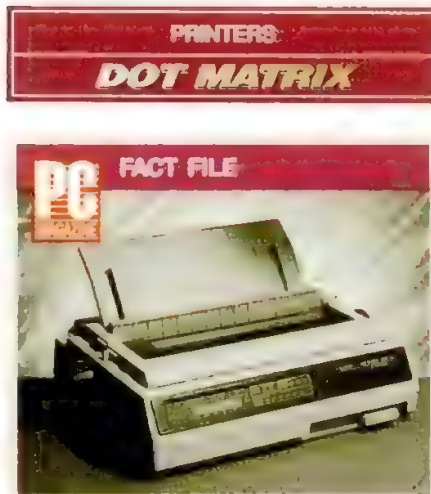
This printer produces text and graphics of exceptionally high quality. In its initial review, we complained that the output was not dark enough, but this no longer seems to be a problem. In its native Okidata mode as well as in IBM Proprinter and Epson LQ emulations, the 393 Plus generated graphics that looked spectacular for dot-matrix output, thanks largely to the printer's 360-by 360-dpi maximum resolution. When it comes to text, even the 10-cpi draft mode, dubbed utility mode by Okidata, is quite

FONTS & FEATURES				
Okidata Microline 393 Plus				
Epson LQ				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

readable.

For letter-quality printing, Okidata has increased the number of resident typefaces in the 393 Plus from one to four. Roman, Helvetica, Orator, and Courier are now available in five sizes, including proportional. Of course, you also get a full selection of character enhancements. Okidata promotes the fact that the 10-cpi, 12-cpi, and proportional versions of the letter-quality typefaces are Bitstream fonts. As with the other Okidata models, typefaces can be chosen from the front panel using the printer's Menu Select or through escape sequences. Okidata sells optional font cards at \$27 per card.

The average of 167 characters the 393



Okidata Microline 393 Plus

Okidata, 532 Fellowship Rd., Mount Laurel, NJ 08054; (800) 654-3282, (609) 235-2600.

List Price: \$1,499; upgrade to 40K, \$99; font cards, \$27; single-bin cut-sheet feeder, \$399; dual-bin feeder, \$699; pull tractor, \$79; color option, \$20.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 12 x 19.5 x 26 in.

Weight: 37 lbs.

Emulations: Epson LQ, IBM Proprinter.

In Short: This hefty, 24-pin printer produces exceptionally good text and graphics output and does so quickly. If you're in the market for a mid-range, high duty cycle printer, the 393 Plus is a good choice.

CIRCLE 554 ON READER SERVICE CARD

Plus spewed out each second on our speed tests in draft mode represents a 5 percent increase over its performance of three years ago. Okidata claims that the printer's speed has been increased by 15 percent in high-speed mode, but these speed improvements are effective only at 15 and 18 cpi. The printer's letter-quality output passes through the printhead at an impressive clip of 90 cps.

The 393 Plus' paper-handling features are identical to those found on the other 24-pin Okidata dot matrix printers: an easy-to-load rear push tractor; top-feed for single sheets; an optional, \$79 pull tractor for bottom feed; paper parking and zero-forms tear-off; and optional single- and dual-bin cut-sheet feeders, priced at \$399 and \$699, respectively. Each bin holds as many as 170 sheets. Like the 390 Plus and 391 Plus models, the 393 Plus can now easily switch between printing on continuous forms and single sheets when the sheet feeders are installed. The printer accommodates paper as wide as 16.5 inches and as thick as 0.014 inches. Okidata rates maximum stock weight at 24 pounds for bond and 100 pounds for card stock.

Three years ago, the 393 was a good choice for those who had heavy-duty printing requirements of multipart forms, wide forms, or sheets. The new version of this

easy-to-use, high-duty-cycle printer remains ideal for those needs, especially if print quality and NLQ speed are top concerns.

Olivetti DM105S

by Winn L. Rosch

Think of the DM105S as Olivetti's minimalist printer. As such, it may be a commendable machine—a narrow-column dot matrix printer with a 200 cps rating and the ability to emulate several other basic printers: the IBM Graphics Printer, the IBM Proprinter, and the Epson FX-80 series.

At \$399 list, the 6- by 15.5- by 10.3-inch (HWD) DM105S is a good bet for adding hard copy output on a bona fide budget that tightens with every twist of the economy. It also adds four-color printing capability and Epson JX-80 emulation for control.

With its 9-pin printhead and four-level platform that holds the ribbon cartridge around the DM105S's printhead, the printer produces identical-quality output at a resolution of 144 by 72 dpi.

The benchmark results given for the DM105S produced about 67 cps in draft; 21 cps when quality counts. Text quality was comparable to that offered by low-end Epson printers, which the machine emulat-

FONTS & FEATURES				
Olivetti DM105S				
Epson FX				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

ed perfectly—even in the color modes of the DM105S. Graphics speed wasn't bad—about 0.3 gppm—but the quality was below par, even for a 9-pin dot matrix printer.

In color printing, the DM105S lags behind somewhat because it lacks a dedicated motor for shifting its ribbon between colors. Instead the DM105S must pause and shift its printhead all the way to the left of the chassis to jog its ribbon to the proper position for each color. This has a considerable slowing effect. The four-color ribbon will produce eight colors on paper by overprinting.

Although the DM105S is obviously an inexpensive printer, a lot of thought and a

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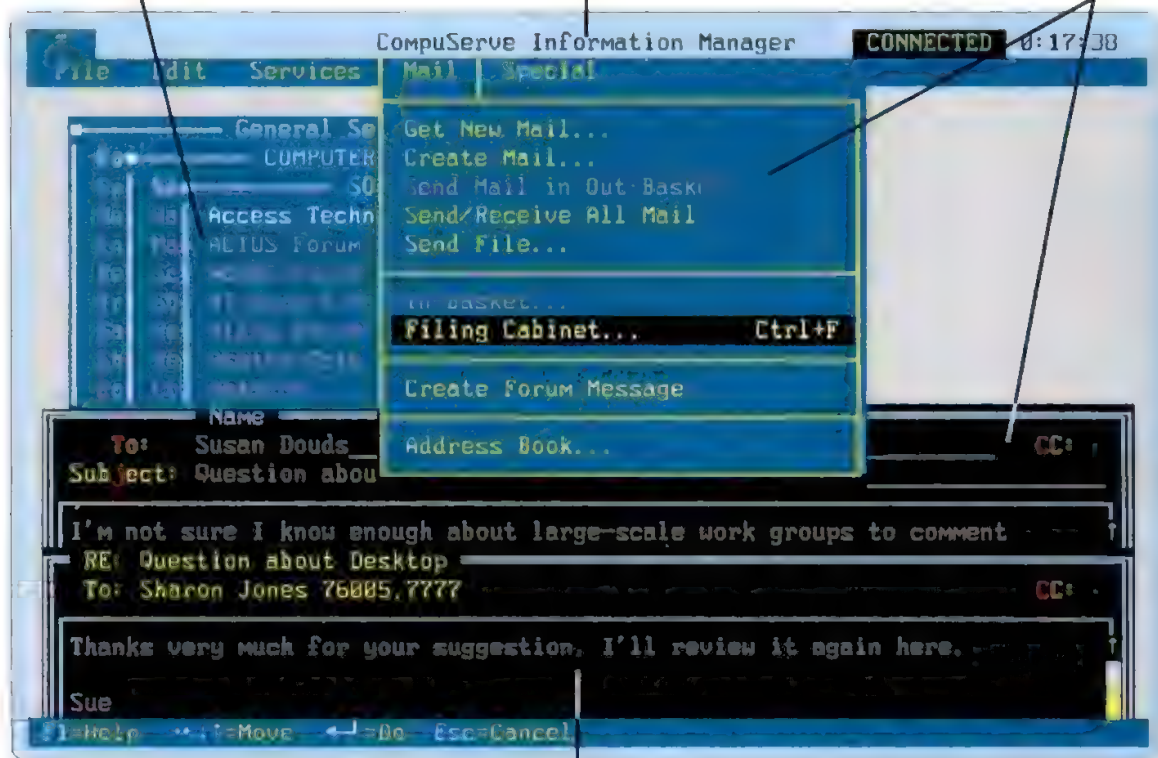
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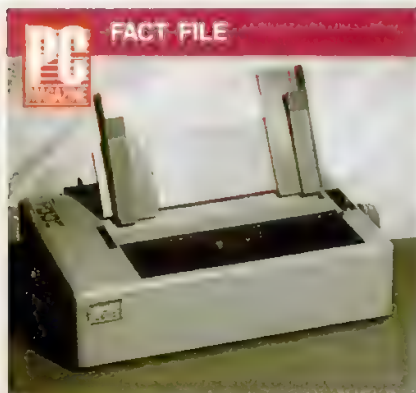
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CIRCLE 226 ON READER SERVICE CARD

**Olivetti DM105S**

Olivetti Office USA, 765 U.S. Highway 202,
Bridgewater, NJ 08807; (201) 526-8200.

List Price: \$399; single-bin sheet feeder, \$75.

Standard Warranty: One year on parts and labor

Dimensions (HWD): 6 x 15.5 x 10.3 in.

Weight: 9.5 lbs.

Emulations: Epson JX, IBM Proprinter; IBM Graphics Printer.

In Short: This 9-pin unit provides color capability providing acceptable color output at low speed for a low price.

CIRCLE 655 ON READER SERVICE CARD

little luxury has gone into its basically square design. For instance, to keep the impact clatter from leaking out underneath the chassis, Olivetti has given the machine desk-hugging foam rubber skirts that are hidden just out of sight.

Mechanical controls on this printer are minimal. A big platen knob positions paper and a single bail arm releases platen pressure for fine adjustments. The electronic controls—just three membrane switches—are located at the left rear corner at the top of the case. Two of these control line feed and form feed. The one marked "local" switches each printer on- or off-line, although contrary to common industry practice, a single LED indicator lights up when the printer is off-line. When used together with the power switch, the switches do double duty and manage printer setup.

Where Olivetti saves in minimizing controls, you pay in the long run for paper. The DM105S use a paper-based menu control system, meaning that every time you change a printer parameter you churn through another sheet (or two or more) of paper—one that should be at least 15 inches long if you need to wade through the entire setup menu. In truth, the menu system isn't hard to understand after the first run-through, but it gets tedious fast should you want to change between draft and near-letter-quality often. You'll want to stick to software commands for these functions.

In testing, controlling the DM105S proved idiosyncratic, hinting at a possible problem area. For example, when the DM105S was turned on, it would often refuse to switch out of its local mode and consequently would not print. The printer had to be switched off and the printhead moved by hand from its full-left position to bring the machine back to life. The membrane switches that control various functions were also unresponsive at times. Sometimes more than moderate pressure was necessary, and the area of finger contact to the switch proved quite critical.

On the other hand, for an inexpensive printer, this little Olivetti has a well-made feel despite its plastic shell being on the flimsy side. But the standard-equipment external pull-tractor will definitely make you think twice about quality. The sliders that its sprockets are mounted on don't even lock in place laterally and had a tendency to drift during long print jobs.

**At \$399 list, the
Olivetti DM105S is a
good bet for adding
hard copy output on a
boa constrictor
budget that tightens
with every twist
of the economy.**

Continuous paper loads into the DM105S easily, traveling around the platen and up to the external pull tractor. But continuous multipart forms can be no thicker than an original and a single copy.

To help load single sheets, Olivetti includes a paper feed device that amounts to little more than a plastic guide tray. The optional (\$75) 50-page-capacity cut-sheet feeder was not received for review. Mounting arms for paper rolls are also available optionally.

This Olivetti uses clamshell ribbons that snap easily into place. The DM105S accepts both a multiband black ribbon at \$25 and a four-color ribbon that Olivetti has not yet priced.

Clearly DM105S isn't a heavy-duty machine. It's best for occasional printouts at home or for business applications where price counts more than anything else.

Olivetti DM309E

by Winn L. Rosch

The Olivetti DM309E from ISC-Bunker Ramo shows positively that Italy's contribution to style is not limited to high-fashion clothes. Distinctive in its own way, this narrow-carriage 9-pin impact dot matrix printer may win your heart not just for its looks but for what it can do.

While it's not particularly quick compared with other printers near its steep \$750 price, the DM309E handles its job with quiet mastery. In its highest-quality modes, its output will never cause you to have second thoughts about using it for correspondence or reports.

As with Italian suits and sports cars, the styling of the DM309E will evoke a response from either your heart or your spleen. Basically, it's a flat block measuring 9.5 by 18 by 14.8 inches (HDW) that has rounded corners and a two-tone medium grey finish. Around the edge is what might be described as magnified milling: molded vertical accents that prevent the front and sides from looking too bland.

FONTS & FEATURES				
Olivetti DM309E				
IBM Proprinter 8-pin				
	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

If anything, the DM309E conjures up an image of a contemporary typewriter. It has the same big rubber platen, complete with a large knob on the right for spinning paper through the mechanism. The platen and printhead are both protected by a double-hinged clear plastic cover.

The tractor and platen form the heart of the DM309E's basic rear-feed push-tractor design, which handles sprocketed paper up to 9.5 inches wide and multipart forms up to 0.014 inches thick (the equivalent of two 20-pound sheets or three 11-pound sheets). Olivetti recommends an external unidirectional tractor (a \$70 option) to help pull such thick forms through the machine. The typewriter-style mechanism will also



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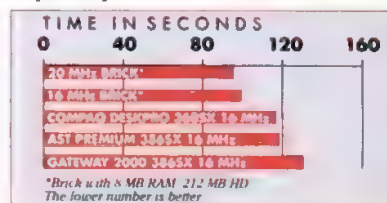
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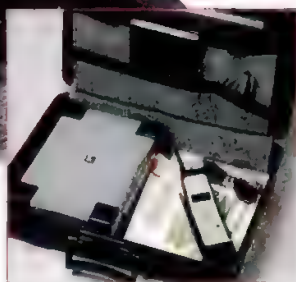


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— PC MAGAZINE, Sept. 1990



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The Brick is only about the size of a ream of copier paper, yet you can still add up to two ISA half cards internally, (one card with a floppy drive). A docking port allows easy, drop-in connection to our Docking Terminal, (\$249, available Q1 1991) which instantly hooks up all cables and provides another 16-bit 3/4 length slot. The "stretch" version of the Brick accommodates full length cards.



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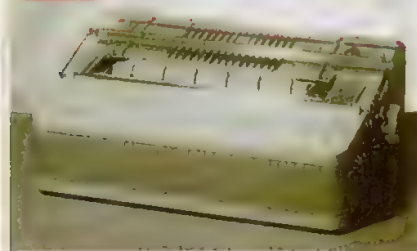
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FACT FILE



Olivetti DM309E

Olivetti Office USA, 765 U.S. Highway 202, Bridgewater, NJ 08807; (201) 526-8200.

List Price: \$750; external tractor, \$70; single-bin cut-sheet feeder, \$250; second bin for sheet-feeder, \$150.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 9.5 x 18 x 14.8 in.

Weight: 21 lbs.

Emulations: Epson FX, IBM Proprinter, Olivetti 12/14.

In Short: This medium performance 9-pin printer produced great text output very quietly.

CIRCLE 656 ON READER SERVICE CARD

handle individual sheets manually or automatically using an optional \$250 single-bin cut-sheet feeder. A second bin can be added for another \$150.

Paper loading is as intuitive as on a typewriter, and changing the \$15 clam-shell ribbon cartridge is similarly quick and clean. The DM309E can park paper by explicit command so that continuous forms can be torn off without wasting a sheet on every print job.

The DM309E printhead is driven speedily along by a rubber belt along a chrome steel tube. It moves precisely and quickly, generating 144 characters per second in its fastest draft mode and about 50 in its best-quality mode. And its 240- by 144-dpi resolution produces a sharp image. Graphics speed was normal, requiring 0.9 gppm for the test page using IBM Proprinter emulation.

Another recommendation of the DM309E is its remarkably quiet operation, thanks to such details as the plastic printhead chamber cover, the foam rubber lining inside the printhead chamber, and the foam rubber skirt hidden around the bottom edge of the machine.

The control panel of the DM309E is liable to raise some eyebrows, if only because of its five unusual membrane switches: tiny baby-blue double domes in squishy rubber. These are augmented by a row of 12 LEDs that indicate various settings. Although these LEDs look somewhat perplexing at first, once you learn the com-

PRINTERS

DOT MATRIX

mand sequences, control is straightforward.

Both the initial printer setup for default modes and the selection of parallel or serial port (both are standard) parameters are accomplished by a nested menu system controlled by the five membrane pushbuttons. The printout paper presents you with menus, and the printhead position indicates the current menu choices. Though it sounds odd, it's simple once mastered.

Although the DM309E has a hidden slot for a credit-card-size emulation cartridge, the printer comes with the slot already filled, and no extra cartridges are available. The included card adds an Epson emulation to the DM309E's standard IBM emulation and the suffix "E" to its name.

The DM309E is a thoroughly likable printer, perhaps the best in the Olivetti line. However, it's weighted down by too high a price for its performance level.

Olivetti DM600S

by Winn L. Rosch

The Olivetti DM600S from ISC-Bunker Ramo not only looks like a generic wide-carriage printer—it acts like one, too. But that's good: It offers a wide range of emulations so it can accept most of the dot matrix or daisy-wheel commands that you send to it. Both its speed and its quality are reasonably high, thanks to a 330-cps rating and a full 24-wire printhead, so the DM600S should be able to rip through

FONTS & FEATURES

Olivetti DM600S

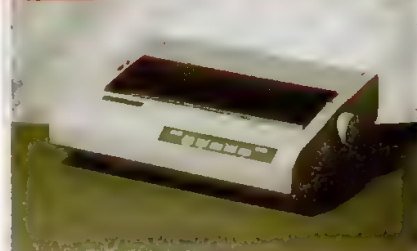
Epson LQ

	Bold	Italic	Sub Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

most ordinary output chores with ease. Just about its only drawback is its heavy-duty price: a whopping \$1,895.

The most conventional of the Olivetti impact dot matrix printers reviewed here, the DM600S is a typical, big rubber-platen printer. Although its case is made entirely out of plastic, the overall assembly of the machine feels heavy and rugged. On the other hand, the machine bends noticeably

FACT FILE



Olivetti DM600S

Olivetti Office USA, 765 U.S. Highway 202, Bridgewater, NJ 08807; (201) 526-8200.

List Price: \$1,895; external tractor, \$160; single-bin cut-sheet feeder, \$480; two-bin sheet feeder, \$660.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 8 x 21.5 x 12.8 in.

Weight: 32 lbs.

Emulations: Epson LQ, Epson FX, IBM Graphics Printer, Diablo 630, Olivetti DM580, Olivetti 12/14.

In Short: A generic wide-carriage, 24-pin printer with moderate speed and quality, the DM600S falls short of the expectations hinted at by its high price.

CIRCLE 657 ON READER SERVICE CARD

when you apply pressure to it.

The mechanical layout is conventional: a printhead chamber in front, lined with foam, holds a belt-driven printhead. Paper feeds in from the rear, winding around the platen and out. The only notable touch is that the entire front half of the shell pivots forward for access to the harmonica-style fabric ribbon cartridge. Ribbons list for about \$14 and last for about 3 million characters.

Only friction feed and an internal unidirectional tractor are standard with the DM600S. An external bidirectional tractor (recommended for graphics) and cut-sheet bin feeders (single and double) are options, priced at \$160, \$480, and \$660, respectively. Paper loads easily, thanks to the typewriter design that gives you a platen knob for direct control. Only a short arc of the knob projects from the right side of the case, however.

The only other outside mechanical adjustment is the platen release level on the left. Inside, the printhead can be adjusted for wear and multipart forms.

When put to work, the DM600S mechanism responds with alacrity. Although we found the machine to be adequately fast with text—172 cps in its quickest high-speed draft mode and about 75 cps in near-letter quality—it does not qualify as a speed demon.

Its Epson graphics mode is slow as well—1 gppm—but yields dark, sharp images. Its default resolution is 120 dots per inch, although in NLQ it can run under 360 by 180 dpi.

The jaunty operation of the DM600S exacts a noise penalty. Though the DM600S is not a particularly loud machine, its whiny, high-pitched rattle is penetrating. Part of the reason for this is the absence of a bail wire. While the lack of a bail wire does not create any difficulties loading and printing single sheets, it adds to the noise because the loosely held paper resonates more freely.

The control panel of the DM600S, located on top at the front, includes a 16-character LCD panel that displays a multi-branched tree menu system. Seven membrane switches allow you to make set-

**The Olivetti DM600S
looks and acts like a
generic wide-carriage
printer—but
that's good: it offers
a wide range of
emulations.**

up adjustments at power-up time and let you select fonts and typefaces during normal operation.

One of the nicer features of the DM600S is that it offers a variety of emulations, ranging from its native Olivetti mode to daisy-wheel emulations (Diablo and Qume) and all the way to Epson and IBM Graphics Printer. A cartridge slot at the front edge lets you add fonts.

Compared with the competition, the DM600S has little to recommend its premium price. An inexpensive laser printer would be faster and would offer better quality. On the other hand, the DM600S can handle multipart forms and wide sheets; it also offers an unusual variety of emulations. In addition, its LCD-displayed menu system makes operation easier. This unusual combination of features may have enough appeal to offset its high price.

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CIRCLE 281 ON READER SERVICE CARD

Panasonic KX-P1624 Panasonic KX-P1695

by Ann Sherman

They're big, they're bad, they're . . . identical. Almost. This year Panasonic offers two wide-carriage dot matrix printers that are furnished with the same case and sell for the same price. The difference? In the pins. The KX-P1695 offers good 9-pin output at a fairly brisk speed, while the 24-pin KX-P1624 concentrates on excellent letter-quality print at a slower pace. If you place a high bounty on excellent paper-



handling and a do-everything front panel, the \$700 list price is reasonable for the 1695 and quite a bargain for the 1624. Of course, it's more likely that you'll be paying street prices of about \$339 for the 1624 and about \$399 for the 1695.

Between its Epson FX default and IBM Proprinter emulations, the 1695 offers eight resident typestyles: Roman, Courier, Sans Serif, Prestige, Script, Bold PS, and a Courier-like draft in pica and elite. The output is generally good, with the Sans Serif typeface being the most attractive and smoothest of the bunch. Stay away from Script: its step-like edges scream 9-pin printhead.

Emulating Epson LQ 2500 and IBM Proprinter command sets, the 1624 offers all the typefaces of its 9-pin cousin except Roman. The letter quality output—including Script—is excellent, and Bold PS characters stand out as particularly dark and well-formed.

Both the 1642 and 1695 offer an ample number of pitches: You can print in 10, 12, 15, 17 (compressed), and 20 cpi—all of which can be expanded to double wide. Enhancements include italics, boldfacing, underlining and overlining, superscripts and subscripts, and double-high printing.

Set for bidirectional printing, the printers delivered copy at a brisk speed. The

1695 turned out our two-page test document at about 140 cps in the pica draft (Epson) default and 55 cps in 10-pitch Courier. The 1624 is, of course, slower: about 96 cps in draft and 47 cps in NLQ under Epson emulation. But given the improvement in quality brought by its 24-pin printhead, the loss in speed is a fair trade-off—especially when you're printing in letter quality mode.

When printed by the 1695, our scanned photo image looked as fine as any that a 9-pin printer could produce. The results of the speed test were also good: 1.7 gppm in IBM mode and a slightly slower speed of 1.3 gppm in Epson mode. The 24-pin 1624 reproduced the scanned image with a more detailed range of densities. However, in Epson mode the thicker patterns on our gray-scale bar blended into a single black swatch. Its speeds were 1.2 gppm in Proprinter mode and 0.8 gppm in Epson mode.

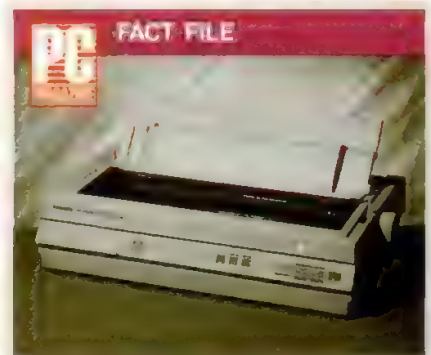
While the 1624 is a relatively quiet printer, the 1695 is high-pitched and grating. Moreover, quiet mode—standard in

**The Panasonic
printers' front panel
lets you access a host
of features via a
multilevel function
system that's as well-
designed as the paper-
handling functions.**

both printers—is relatively ineffective in the 9-pin version: the sound reduction of 4 dB does not offset a 50 percent loss in speed.

The differences between the 1695 and 1624 end with performance and sound. In feature selection and paper-handling, the two are identical.

In a smooth, jamless flow, the internal push/pull tractor accepts continuous forms from rear, bottom, and front feeds. A paper-parking feature, available with the rear feed, asks only that you load paper on the pins, shut the front cover, and pull a lever:



**Panasonic KX-P1624
Panasonic KX-P1695**

Panasonic Industrial Co., 2 Panasonic Way, Secaucus, New Jersey 07094; (800) 742-8086
List Price: \$700 (either unit); upgrade to 32K, \$60; DB-25 serial interface, \$90 (9,600-bps), \$110 (19,200-bps); single-bin cut-sheet feeder, \$240

Standard Warranty: Two years on parts and labor.

Dimensions (HWD): 6 x 28 x 17.6 in.

Weight: 31 lbs. (KX-P1695); 32 lbs. (KX-P1624)

Emulations: Epson FX, IBM Proprinter (KX-P1695); KX-P1624, Epson LQ, IBM Proprinter (KX-P1624).

In Short: Sporting identical cases,

comprehensive front panels, and excellent paper-handling capabilities, these wide-carriage printers differ mainly in specialty. The 9-pin KX-P1695 emphasizes fast speeds, while the 24-pin KX-P1624 concentrates on fine letter-quality output.

CIRCLE 674 ON READER SERVICE CARD

the form rolls right up to the printhead. Another pull will tuck the paper back under the platen. You can rip off forms as you need them with the help of a paper-cut mechanism—all you need to do is push a button to roll the perforation line up to a tear bar; pushing it again brings the top of form back down to the printhead. Both the KX-P1624 and KX-P1695 easily accept card stock, multiple forms up to 0.013 inches thick, and envelopes.

The front panel lets you access a host of features as well-designed as the paper-handling functions. You may want to close the box when you find so many—almost too many—options, but you'll discover that using the multilevel function system will become second-nature after a few days. The top layer lets you adjust the usual top of form, line feed, form feed, and on-line options.

Press the function button to access a control table with cycle-through LED lights. This table lets you temporarily adjust font, pitch, form length, lines per inch, and margins. At this level you can also store groups of settings in macros.

Press the function button as you power up to transform the same matrix of columns and rows into a third level of options.

There's no need to arm yourself with a pen light, magnifying glass, and screw driver: emulation, font, international character sets, and 17 other defaults normally set with DIP switches are accessible in this mode.

These two printers are well-documented and offer the most up-to-date dot matrix technology. If you have a laser and you want a printer that will generate quick drafts, the KX-P1695 is worth a look. However, if you need one printer to cover a broad range of print jobs, the KX-P1624 is a very good bargain. Its letter-quality fonts are beautiful and its draft speed is acceptable.

Seikosha SL-90

by John R. Quain

Seikosha's SL-90—a 24-pin, narrow-carriage version of its 9-pin SP-2000—turned out to be a one-hit wonder. The only song this \$499 tractor-fed machine will play is Epson LQ-850. And like its less-expensive counterpart, it's not intended for heavy-duty workouts; it's more comfortable fol-

FONTS & FEATURES Seikosha SL-90				
Epson LQ				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

lowing just one conductor.

Aside from its greater number of pins and larger price tag, the SL-90 offers more memory (12K, fixed), a \$50 eight-font ROM option (Elite and Pica are standard), sharper output—and a nearly identical chassis. Consequently, it has many of the same features and some of the same drawbacks. It's a cinch to load and is up and running in no time. The on/off switch is conveniently situated on the front (below the four-button membrane control panel), and a recessed Centronics parallel port keeps the computer connection out of the paper's way. The DIP switches—you'll have to find them if you want a slashed zero—are located beneath the ribbon cartridge. But, also like the SP-2000, the SL-90 has a one-inch tear-off and a dark, translucent paper cover that makes it difficult to tell whether or not you're at top of form.

PRINTERS DOT MATRIX



Seikosha SL-90

Seikosha America Inc., 10 Industrial Ave., Mahwah, NJ 07430; (800) 338-2609, (201) 327-7227

List Price: \$499; eight ROM fonts, \$50; single-bin cut-sheet feeder, \$169

Standard Warranty: Two years on parts and labor.

Dimensions (HWD): 4.4 x 15.5 x 13 in.

Weight: 8.6 lbs.

Emulations: Epson LQ.

In Short: More pins, more options, and better graphics raised this Seikosha above its 9-pin counterpart, but slow text speed and chassis shortcomings may dissuade more than a few buyers.

CIRCLE 675 ON READER SERVICE CARD

More to the point, though, is the improvement in graphics and NLQ text quality that the SL-90 offers. Although it wasn't particularly speedy in either mode—1.5 gppm and 40.7 cps in NLQ—gone was the streaking problem of the SL-2000, replaced with better gray-scale and halftone production. Although, to our surprise, text results in the default NLQ mode were only infinitesimally sharper than those of the 9-pin printer, more of a difference became apparent when outputting the high-order IBM character set: print quality was certainly sharper than that of its 9-pin counterpart.

Text speed in draft, however, didn't bear up as well. Instead of the 120 cps this printer should have turned out (it's rated at 240 cps), the SL-90 managed to produce only 63 cps. Increasing the character count to 15 characters per inch didn't help much.

Moreover, text quality in draft mode was inferior to that of the SP-2000: We found it more difficult to read because of its lighter appearance. Although the SL-90's draft print was not blurred or smudged, close inspection revealed that the horizontal and curved elements of the characters received fewer hits than the vertical. The result was text that can nearly disappear under less-than-optimal light conditions.

Since the 24-pin SL-90 still suffers from some of the same drawbacks—such as a flimsy paper bale and narrow platen—as its 9-pin sibling, SP-2000, the improvement in graphics and NLQ speed may not be enough to justify choosing it. Other drawbacks, such as the lack of locking tractor-adjustment toggles, also give the impression the SL-90 is inappropriate for heavy-duty jobs. At the same time, its \$499 list price is a bit steep when compared with that of other 24-pin printers in our roundup, but you should be able to find it at prices discounted below the \$300 point.

Seikosha SP-2000

by John R. Quain

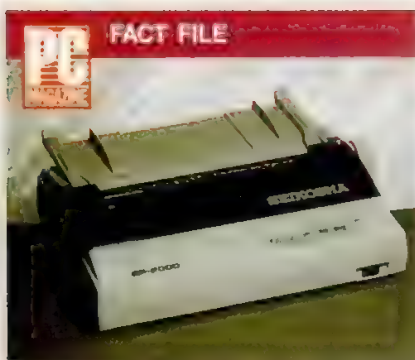
Corporate history in the computer business being what it is, Seikosha can boast one of the more extensive printer manufacturing records. The company has been making dot matrix printers since 1973—longer than most companies in this roundup. While the SP-2000 may not seem to be the culmination of years of experience, it's meant for customers of more modest means—and requirements.

The SP-2000 represents the low end of Seikosha's line of 13 dot matrix machines. It lists for \$329, but you can expect to find street prices in the vicinity of \$260. A still lower price would make this machine a more attractive catch, but for a 9-pin, narrow-carriage printer that offers sharp draft output and both IBM Proprinter II and Ep-

FONTS & FEATURES Seikosha SP-2000				
Epson FX				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

son FX-850 emulations, it's not a bad deal.

The small-business user who wants simple text output and doesn't have a lot of time to spend setting up the printer and learning commands will find that the SP-2000 offers a simple push-tractor, harmonica-style ribbon setup. If you get stuck—which you shouldn't—the documentation is easy to follow, although the control code explanations are a bit curt. A front-panel, four-button membrane keypad allows you, among other things, to



Seikosha SP-2000
 Seikosha America Inc., 10 Industrial Ave.,
 Mahwah, NJ 07430; (800) 338-2609, (201) 327-
 7227
List Price: \$329
Standard Warranty: Two years on parts and
 labor
Dimensions (HWD): 4.4 x 15.5 x 13 in.
Weight: 7.3 lbs.
Emulations: Epson FX, IBM Proprinter.
In Short: This 9-pin offering had good draft-
 quality output and a straightforward setup. Poor
 graphics printing and an unwarranted list price,
 however, reduce its appeal.

CIRCLE 678 ON READER SERVICE CARD

switch between draft and NLQ and per-
 form paper parking for single-sheet print-
 ing. To get to the IBM emulation, howev-
 er, you need to raise the ribbon in order to
 adjust a DIP switch setting.

The SP-2000 comes with a 1K buf-
 fer—enough for unexceptional print tasks.
 If you find out that you do have a need for
 additional memory, the SP-2000 has an
 open socket to accommodate another 7K,
 yielding a total of 8K. You're going to
 have to procure the upgrade from another
 company, however: Seikosha America
 does not offer the memory option at the
 present time. Two fonts are included, Pica
 and Elite, with various enhancements
 ranging from double height and width to
 double strike and italic. No additional
 fonts are currently available.

As for type quality and speed, the SP-
 2000's print performance was virtually the
 same in both Epson and IBM modes. Ep-
 son draft text speed clocked in at 86 cps.
 It's not one of the quickest times around,
 but it's certainly respectable within its
 class. The SP-2000 did produce one of the
 sharper 9-pin draft-quality prints on our
 benchmark tests: light but not blurry or dis-
 torted. At 27 cps, the near-letter-quality
 print in Epson mode was slower than in
 comparable machines, although the qual-
 ity was good. It was sufficiently dark for
 business correspondence and it didn't pro-
 duce the furry edges that can sometimes
 plague 9-pin output.

In PC Labs's graphics speed tests, the

PRINTERS DOT MATRIX

Epson mode yielded 0.8 gppm, while the
 IBM emulation did a little better at 1.0
 gppm. Quality in this case was not what it
 could have been, though. In each of our
 tests, the SP-2000 trailed black ink into
 and out of the halftone and produced a
 black scale rather than a gray one. Adjust-
 ing the printhead's distance from the plat-
 en did not alleviate the streaking. To its
 credit, the SP-2000 survived the graphics
 emulation and speed tests, but the streak-
 ing precludes it from all but marginal
 graphics uses.

Paper feeding wasn't quite trouble-

**The Seikosha SP-2000
 produced one of the
 sharper 9-pin draft-
 quality prints on our
 tests—fairly dark
 and without the furry
 edges that sometimes
 plague 9-pin output.**

free, either. One particular problem was
 the SP-2000's propensity to jam at paper
 folds, a problem caused mainly by its
 lightweight paper bale. Another contribut-
 ing factor is that the roller (platen) is less
 than 9 inches wide, while typical fanfold
 paper is more than 9.5.

In defense of the SP-2000, paper jams
 were few and far between; however, their
 occurrence is an indication of the ma-
 chine's insubstantial design. On the other
 hand, the tractor feeds do allow you to
 move the paper anywhere along the width
 of the platen to enable one-up label print-
 ing. Seikosha does not recommend paper
 stock that is any heavier than 21 pounds
 (0.2 mm thick).

All in all, the SP-2000 is a lightweight
 among printers, with the distinction of of-
 fering above-average draft-quality type for
 users demanding nothing more than use-
 able print without control-code consterna-
 tion. The machine's slight construction
 and streaky graphics output, however,
 makes it better suited for short-term, text-
 only tasks.

Star Micronics NX-1500

by Ron Goldberg

The Star Micronics NX-1500 is a rugged
 9-pin dot matrix printer that stresses fea-
 tures over fast performance. Although the
 \$499 wide-carriage printer won't set your
 office on fire with its blazing speed, it does
 offer a decent supply of resident type
 styles, Epson FX and IBM Proprinter II
 XL emulations, an easy-to-use control
 panel, and reasonably quiet operation.

You'll find that setting up the 5- by
 23.2- by 13.1-inch (HWD) NX-1500 is
 made simple by Star Micronics' documen-
 tation. Upon installing the printer we had
 only one complaint: its Centronics parallel
 connector is located on the side of the ma-

FONTS & FEATURES				
Star Micronics NX-1500				
Epson LQ				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

chine near the front, which means you'll
 end up with a thick, bulky wire in an in-
 convenient place. Otherwise the printer is
 very solidly built, and the company backs
 up its construction with a two-year parts
 and labor warranty.

Once you set up the printer, working
 through its different functions is a breeze.
 A series of LEDs on the NX-1500's con-
 trol panel lights up each of the printer's
 NLQ font choices: Courier, Sans Serif,
 and Orator. You access the NX-1500's
 draft mode by scrolling through the
 choices until none of the LEDs are lit.

To change pitch you hit a raised button
 to scroll through your options, including
 10 cpi, 12 cpi, compressed, and propor-
 tional. You can dress up your text with
 boldfacing, italics, and underlining, print
 superscripts and subscripts, and add such
 formatting enhancements as double-high
 and double-wide characters, compressed
 type, and vertical and horizontal tabs,
 among others. The NX-1500 can print
 high-order IBM characters under IBM
 Proprinter emulation.

Next to the NX-1500's font and pitch
 buttons are three switches: paper
 eject/park, paper feed (which handles both
 line feeds and form feeds and which moves

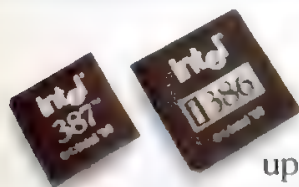


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- ☐ 1. Share access to one or more printers or plotters
- ☐ 2. Share access to a modem
- ☐ 3. Exchange electronic mail and messages with other users
- ☐ 4. Electronically transfer data files between computers (rather than pass diskettes)
- ☐ 5. Access a common library of data files, like drawings, document templates, memos, boilerplate, etc.
- ☐ 6. Access a common database, where multiple users must access the same records simultaneously (e.g. an order entry system)

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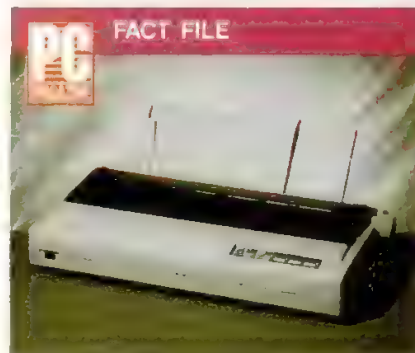
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PRINTERS

DOT MATRIX

in forward and reverse), and on/off-line. When you press this last key in tandem with the park switch, you move the paper to the top-of-form position.

Fanfold paper or three-part forms enter the NX-1500 through the rear and travel in a U-fold path. Paper-handling options include a \$249 single-bin sheet feeder and a \$59 adjustable pull tractor.



Star Micronics NX-1500

Star Micronics America Inc., 420 Lexington Ave., Suite 2702, New York, NY 10170; (800) 447-4700.

List Price: \$499; 8K serial buffer cartridge, \$110; single-bin sheet feeder, \$249; adjustable pull tractor, \$59.

Standard Warranty: Two years on parts and labor.

Dimensions (HWD): 13.1 x 23.2 x 5 in.

Weight: 23.6 lbs.

Emulations: Epson FX, IBM Proprinter.

In Short: The NX-1500 offers satisfactory performance for its price point, with a convenient and user-friendly interface. Graphic and text output are both above average, but printer speed in either mode was unspectacular. Consider the NX-1500 a small station wagon, as opposed to a sports car.

CIRCLE 877 ON READER SERVICE CARD

As for performance and print quality, in our tests the NX-1500 delivered reasonably sharp images at a rate of 0.8 gppm under its default Epson FX emulation. Under IBM Proprinter XL emulation, the NX-1500 sped up to 0.9 gppm, but the quality of its output was slightly poorer.

The NX-1500's text speed was on the slow side of average in our tests. In its default Epson emulation, we timed the printer at 91 cps in draft and a tedious 27 cps in NLQ. NLQ mode also yielded an unremarkable improvement in text quality.

Is the NX-1500 truly a star? Not really, but then again, it isn't intended to be. If you're looking for an honest day's work from a printer without having to worry about its dependability or struggle with its complexity, consider the Star Micronics NX-1500.

Star Micronics XR-1000 Multi Font

by Carol Levin

Star Micronics recently reduced the price of its high-end 9-pin XR-1000 Multi Font from a hefty \$629 to a slightly more palatable \$549, including the \$50 color option. Even with this price reduction, the narrow-carriage color-capable XR-1000, a small-business workhorse, is the most expensive 9-pin printer from Star Micronics that we're looking at this year. It follows on the heels of the XR-1500 Multi Font, the wide-carriage version that we reviewed in our last roundup of printers (for a review of the XR-1500 see the Printer Blockbuster Issue, November 14, 1989).

Rated by the company as the fastest of all its dot matrix printers, the unit performed respectably, if not extraordinarily, on the PC Labs text speed tests. Under its default Epson FX emulation, the XR-1000 printed our test document at a rate of 124 cps in draft mode and 48 cps in NLQ. In our color graphics speed tests, however, the unit plodded along at 0.3 gppm under Epson EX emulation.

You can switch the XR-1000 from its default Epson emulation to IBM Proprinter emulation by setting DIP switches. This is something of a disappointment, given the fact that more and more printers in this price range let you change emulations through soft settings.

The XR-1000's color option is factory installed, so you won't find instructions for

PRINTERS DOT MATRIX

XR-1000 has several other attractive features, among them a ribbon rated for long life, a generous 32K buffer that can be expanded to 160K for \$139, a parallel interface (a serial interface is available for \$100), and eight resident NLQ typestyles (Courier, Sans Serif, Letter-G, Orator, Script, OCR-B, TW-Light, and Cinema). The 5.5- by 17.8- by 13.4-inch (HWD) printer comes with a two-year warranty covering parts and labor; service is available through authorized service centers



and by Xerox. If all else fails, you can send your printer to a mail-in service center in Irvine, California.

In marked contrast to the sleek design of the NX-2410, the XR-1000 has some notable inconveniences. To reach the tractor feed to install continuous-form paper, we removed the top cover easily but struggled with a very stubborn rear cover. When the rear cover snapped back into place, the top cover wouldn't fit snugly back in, which made tearing off the paper difficult. With the pull tractor installed, neither part of the cover fits back on.

Paper-handling features include paper parking to alternate swiftly between continuous and single-sheet feed. While there is no bottom feed when a straight paper path is needed, there is an easily installed pull-tractor option (\$50) and an automatic sheet-feed option (\$160). Instructions for installing the automatic sheet feeder or paper tractor are not included in the manual but come with the options.

The front panel allows access to many printer options; these are supplemented by functions that you enable by issuing escape codes. You can select font, pitch, quiet mode, and some paper-handling settings from the panel, but awkward combinations of key presses take some effort to learn. To guide you in maneuvering

around the front panel, a credit-card-size sticker is included that maps out all the key combinations.

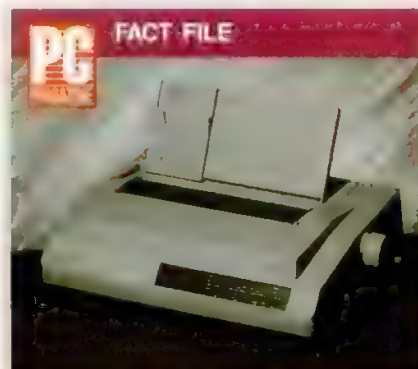
To access all 20 of the printer's options, you have to program them in Memory Switch Mode. Although this facility makes the printer flexible, here again, we found that design detracts from capability. To select settings in this mode, you print out a page of settings and control the placement of the printhead under the menu selections with the front panel buttons. To enter your choice into the printer's memory, you press the on-line button. The menus—command, font, print, paper, and forms—allow you to set such options as graphics direction, font, automatic sheet feeder, and page length.

The printer's manual assumes that the user is fairly experienced and therefore packs a lot of advanced information—including a section on programming the printer using BASIC—into 112 pages. The last page of the chapter on escape codes lists the codes for selecting particular options but offers no further explanation. The manual also neglects to include suggestions for printing on envelopes and multipart forms—in our tests, second and third copies were dull. Star Micronics' customer-support staff suggests adjusting

FONTS & FEATURES				
Star Micronics XR-1000 Multi Font				
Epson FX				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

installing color in the printer's manual. To print in color, just drop in the color ribbon (replacements cost \$20). Over time, you may find that printing color graphics in bi-directional mode, the printer's default, will lead to registration problems. This can be corrected with a procedure that realigns the printhead. It's safer to print graphics in unidirectional mode even though throughput won't be as high.

Besides offering quiet operation, the



Star Micronics XR-1000 Multi Font
Star Micronics America Inc., 420 Lexington Ave., Suite 2702, New York, NY 10170; (800) 447-4700.

List Price: \$499; upgrade to 160K RAM, \$139; 8K serial interface board, \$100; color option, \$50; single-bin sheet feeder, \$160; pull tractor, \$50.

Standard Warranty: Two years on parts and labor.

Dimensions (HWD): 5.5 x 17.8 x 13.4 in.

Weight: 17.6 lbs.

Emulations: Epson EX, IBM Proprinter.

In Short: The Star Micronics XR-1000 Multi Font is a narrow-carriage 9-pin color dot matrix printer that could function as a small-business workhorse. It offers a generous 16-page buffer, a range of soft-selected options including eight resident fonts, and a price tag that has recently been reduced by \$80.

CIRCLE 679 ON READER SERVICE CARD

the gap between the printhead and platen with the five-position lever on the left. Position 3 or 4 will bring the printhead close enough to the platen to print forms effectively.

If you don't find the XR-1000's design inconveniences bothersome and the list price somewhat steep, its options and performance should be sufficient for most 9-pin color printing jobs.

Star Micronics NX-2410 Multi Font Star Micronics NX-2415 Multi Font

by Carolyn Falconer

Released at the same time as the \$659 wide-carriage NX-2415 Multi Font, the \$399 narrow-carriage Star Micronics NX-2410 Multi Font is an upgrade of the vendor's NX-2400, which we reviewed two years ago (see Printer Blockbuster Issue, October 31, 1988). Aside from price and carriage width, the 24-pin NX-2410 and NX-2415 differ in rated noise and speed, buffer size, emulations, control panels, and the types of interfaces they use.

The low-cost NX-2410 has a built-in Centronics parallel interface. It is light and compact, measuring 4.7 by 16.1 by 12.9 inches (HWD) and weighing 14.1 pounds. The 24-pin printer accommodates single sheets or fanfold paper up to 10 inches wide and multipart forms up to three sheets thick. Its control panel, situated on the right side of the front of the case, consists of four membrane switches for style/pitch, quiet mode, paper feed, and on-line. By pressing combinations of these buttons,

FONTS & FEATURES				
Star Micronics NX-2415 Multi Font				
	Epson FX			
	Bold	Italic	Sub/Super	Underline
	10 cpi			
	12 cpi			
Compressed				
Proportional				

you can set many of the printer's functions, including page feed, micro-feed, and paper parking. Informative LED displays keep you apprised of the NX-2410's status, and a beeper sounds when the printer is out of paper.

The NX-2410 provides four built-in LQ

PRINTERS

DOT MATRIX

type styles—Courier, Prestige, Orator, and Script—and one draft type style. You can print LQ characters in pica, elite, condensed pica, condensed elite, and proportional pitches. Star Micronics offers additional fonts—Letter Gothic, Blippo, and OCR B—on optional cards for \$119 each. And you can store downloaded fonts in the printer's 7K buffer, which is expandable to 39K with the addition of a \$139 32K RAM card.

The NX-2410 wakes up in Epson LQ-850 mode, but is also capable of emulating the IBM Proprinter X24. We found that the graphic sample printed under Epson emulation was truer to our original than that printed under Proprinter emulation. In IBM mode the graphic sample is horizontally delineated with denser printing and is

For the Star Micronics
NX-2410 and NX-2415,
you can set such
functions as form feed
and paper parking by
pushing button
combinations on the
control panel.

slightly out of proportion. Both emulations supported text well, with easy-to-read draft characters and clear, smudge-free letter quality output printed in a dense matrix of 24 by 35 dots.

In our text speed test, we timed the 2410 at 91 cps in 10 cpi draft mode under both Epson and IBM emulations—just what we had expected given its rated speed of 180 cps. With a rating of 60 cps in letter quality mode (10-cpi Courier) and a measured speed of 41 cps in both Epson and IBM emulations, the NX-2410 fared better than we had anticipated. In our graphics speed test, we clocked the printer at 0.9 gppm under Epson LQ-1500 emulation.

This model's paper-handling is good, but it can stand improvement. Friction feed is available for handling single sheets, while a push tractor handles continuous forms. A single-bin sheet feeder with a 50-

sheet capacity is a \$125 option. Tractor-fed paper can be easily parked with the 2410's paper-parking function. The only glitch occurs with continuous-form paper, which is threaded over a push tractor through a rear U-fold path. The sprockets holding the holes of the paper in place don't clamp down tightly enough and do occasionally lift up, causing the paper to buckle and jam.

The Star Micronics NX-2415 has many of the same virtues as the NX-2410: It is a sturdy 24-pin printer that is easy to set up and use; it offers four letter-quality type styles and high-quality output, and it accepts the same font cards. Moreover, it uses the same clamshell ribbon cartridges, which are available for \$9.50.

The 5- by 23.2- by 13.1-inch (HWD) NX-2415 can handle paper up to 16.5 inches wide, which makes it ideal for printing spreadsheets and other wide-format documents. Like our NX-2410 evaluation unit, the 20.1-pound NX-2415 came with a Centronics parallel interface, but this time in a removable cartridge rather than as a built-in component. A serial interface cartridge is available for \$110. Other options include a 120-sheet capacity cut-sheet feeder for \$249 and an adjustable



Star Micronics NX-2410 Multi Font
Star Micronics NX-2415 Multi Font
Star Micronics America Inc., 420 Lexington Ave., Suite 2702, New York, NY 10170; (800) 447-4700.

List Price: \$399 (NX-2410); \$659 (NX-2415); upgrade to 39K RAM (NX-2410), \$139; upgrade to 43K RAM (NX-2415), \$139; font cards, \$119 each; single-bin sheet feeder (NX-2410), \$125; single-bin sheet feeder (NX-2415), \$249; adjustable pull tractor (NX-2415), \$59.
Standard Warranty: Two years on parts and labor.

Dimensions (HWD): 4.7 x 16.1 x 12.9 in. (NX-2410); 5 x 23.2 x 13.1 in. (NX-2415).

Weight: 14.1 lbs. (NX-2410); 20.1 lbs. (NX-2415).

Emulations: Epson LQ, IBM Proprinter.

In Short: These 24-pin dot matrix printers sport a variety of built-in fonts and options.

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CIRCLE 241 ON READER SERVICE CARD

external pull tractor for \$59. You can expand the NX-2415's 11K buffer to 43K by adding the optional \$139 32K RAM card.

One of the most noticeable differences between the two models is the control panel. The NX-2415 has five raised buttons for style, pitch, set/eject/park, quiet/paper feed, and on-line. You can access many of the printer's features, including form feed, top of form, and paper parking by pressing combinations of these buttons. The panel also has LED lights that let you determine the printer's status at a glance.

While this control panel is fairly easy to use, it's not as logically organized as that of the 2410. For example, the control panel uses the same button for paper feed and quiet mode, two of the most common functions a user might want. To access either function, you'll first have to remember what to do with the on-line button.

The NX-2415 emulates both the Epson LQ-1050 and the IBM Proprinter XL24 perfectly. This printer did not share the 2410's problem of producing overly condensed graphics in IBM mode. With a higher rated speed of 200 cps in draft mode and 60 cps in NLQ mode and a measured speed of 100 cps in draft and 37 cps in

PRINTERS DOT MATRIX

NLQ, the NX-2415 outperformed the 2410 in our text speed tests. As for graphics performance, the NX-2415 generated our test images at a rate of 0.9 gppm under the Epson LQ-1500 emulation.

Both the NX-2410 and the NX-2415 offer a nice variety of fonts and features, and both produce high-quality output. If you're looking for a low-cost 24-pin printer for either home or office use, the Star Micronics NX-2410 and NX-2415 are good choices.

Tandy DMP 2130

by John R. Quain

The flat-bed design of Tandy's 28-pin, wide-carriage DMP 2130 looks as if it was built to shred paper rather than print on it. But rest assured, the \$1,199 DMP 2130 can handle heavy print loads like a Mack truck and park like a Volkswagen. Unfortunately, it won't give you the speed or smooth lines of Porsche.

Based on C-Tech's C-645 (reviewed in

this issue), the Tandy DMP 2130 offers most of the same features, in addition to its own imprimatur and 7,000-store support chain. Able to run Epson FX-286e and

FONTS & FEATURES				
Tandy DMP 2130				
IBM Proprinter 24-pin				
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

IBM Proprinter XL emulations in Pica and Elite faces, the 2130 is intended for text-intensive operations and can accommodate a variety of paper needs, from 4-inch cables to 15-inch wide fanfold paper. Multipart forms of up to five copies, plus original, can be handled as well. The most obvious difference between the C-Tech model and the Tandy machine is the lack of a serial port on the Tandy model.

Tandy is touting the 2130 as its fastest dot matrix printer. It may also be its clumsiest. Even when the printer is off-line, for example, lifting the opaque cover for any reason, sounds an alarm and the control

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PRINTERS

DOT MATRIX

panel is disabled. We found this feature unusually annoying, particularly in cases where we wanted to move the paper forward a fraction of an inch because of a slight misalignment but were prevented

The Tandy DMP 2130's zero tear-off feature functioned perfectly and, unlike so many other printers, doesn't require you to hold the cover down when you use it.

from doing so. If you put the panel back on, you can't see if you've moved the paper far enough.

On the other hand, the zero tear-off feature functioned perfectly. Unlike so many

other printers, it doesn't require you to hold the cover down to tear the paper. Parking was also a simple matter, and the 2130's 15-character LCD control panel is far from the worst we've seen, allowing you to select the slashed zero, for instance, by pushing a few buttons.

The practical task of printing text rendered some mixed results. Near-letter quality print was steady and firm in the Epson mode—if a little inelegant. Don't expect to see any increase in sharpness because of the extra pins. Even though the NLQ text was dark and heavy, letters tended to have fuzzy edges. Draft print-quality in both emulations was certainly legible but it put lowercase gs through an odd contortion, leaving other descenders untouched.

Although the owner's manual gives the 2130's fastest text speed at 480 cps in the Epson draft mode, the best speed it could achieve (at 12 cpi) was 179.1 cps—about 60 cps less than we expected. Topping out a few cps above 100, the IBM draft-mode numbers were considerably lower than the Epson emulation. Once again, the best let-



Tandy DMP 2130
Tandy Corp., 700 One Tandy Center, Fort Worth, TX 76102; (817) 390-3300.
List Price: \$1,199.
Standard Warranty: One year on parts and labor.
Dimensions (HWD): 8.3 x 24.3 x 17.3 in.
Weight: 33.1 lbs.
Emulations: Epson FX, IBM Proprinter.
In Short: The DMP 2130 is a 28-pin wide-carriage machine for text-intensive tasks. Though it's not as fast as others, the price/performance ratio should draw admirers.

CIRCLE 881 ON READER SERVICE CARD

ter-quality speed the 2130 yielded was in the Epson mode at 67.6 cps (10 cpi) and 74.8 cps (at 12 cpi). IBM emulation numbers were comparable in this case.

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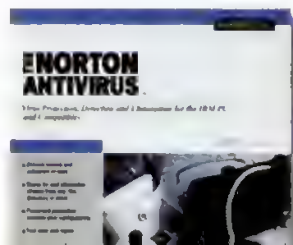
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Computers and Communications

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NEC

The 2130 performed the high-order ASCII character set in Epson and IBM emulations with aplomb. Epson graphic output (at a tested speed of 1.1 gppm) was adequate with discernible—but very light—streaking in the half-tone. Graphics output in the IBM mode (at 1.5 gppm) was better, lacking the subtle printing shifts apparent in the Epson mode.

Tandy provides good documentation with the 2130: a technical reference book and a basic manual on setup. Each of them is logically constructed, and a small reference card in a plastic envelope can be attached to side of the printer for quick reminders. In the final analysis, this is a fine printer for users with multiform and wide-stock printing needs. You won't get anything fancy—or particularly speedy—but you should get solid and reliable performance.

Tandy DMP 240

by John R. Qualin

Tandy's \$550 carbon copy of Citizen's GSX-140 has all the features of Citizen's 24-pin original, save two: The possibility of a lower street price or an extended warranty. Just like the narrow-carriage Citizen model (reviewed earlier in this issue), it offers 24-pin IBM Proprietary, Epson LQ-500 and the LQ-2500 (color) emulations. You'll also get three fonts—Times Roman, Courier, and Prestige Elite—and a color option.

Out of the box, the DMP 240 is not set up for color, but installing the color motor was literally a snap. With a tested graphics

color printing and need more memory, Tandy offers a \$30 upgrade to bring the base memory of 8K up to a total of 40K.

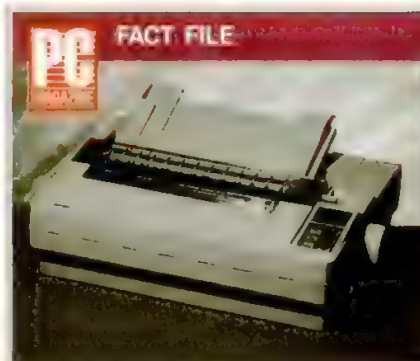
After powering down, if you want to retain the color setting, you need to set up a macro using the control panel. (This was a rather abstruse exercise, but we found the scant documentation was more to blame than the machine.) To switch to black text, you can leave the color motor installed. All you need do is change modes and ribbons. After removing the \$30 four-color ribbon, we decided gloves would have been an appreciated addition.

Overall text speed test results were average. IBM emulation results, which were a shade better than the Epson numbers, came in at 98.5 cps in draft and 46.1 cps letter-quality mode. LQ print quality was sharp and properly saturated, eliminating the blurry edges evident on some 9-pin printers (and other 24-pin printers, for that matter). A pleasant surprise here was the

The Tandy DMP 240 pleasantly surprised us with the quality of its draft output—about the only visible difference between it and LQ was that draft output was lighter.

quality of output in the draft mode; about the only visible difference between it and the LQ mode was that it was lighter. Moreover, the DMP 240's proportional printing was quite pleasing. Black-and-white graphics output was also very smooth—a nice break from the run-of-the-mill results we saw from other vendors.

In terms of construction and layout, the only design idiosyncrasy was the paper bale, which is built into the removable cover (as it is on the Citizen printer). Paper handling was convenient and easy to execute—rear and bottom paths are provided. The DMP 240's excellent paper parking and zero tear-off functions always seemed to work without a hitch or jam.



Tandy DMP 240

Tandy Corp., 700 One Tandy Center, Fort Worth, TX 76102; (817) 878-4969.

List Price: \$550; 32K RAM upgrade, \$30.

Standard Warranty: One year on parts and labor.

Dimensions (HWD): 6.5 x 16.8 x 12.3 in.

Weight: 11.5 lbs.

Emulations: Epson LQ, IBM Proprietary.

In Short: This 24-pin color printer is Tandy's version of Citizen's GSX-140, offering good-quality print and solid colors. Unfortunately, Tandy doesn't offer the two-year warranty or the discount possibilities that Citizen does.

CIRCLE 600 ON READER SERVICE CARD

Since the DMP 240 is virtually indistinguishable from the Citizen GSX-140, the ultimate question is why pay for the Tandy embossed model? There are a number of considerations that count against the Tandy choice: because it's sold through Radio Shack stores and Tandy Computer Centers, discount prices on the DMP 240 aren't likely (whereas you can anticipate that independent dealers will offer reductions on the Citizen machine). Furthermore, Tandy offers a warranty that will get you through about half as much paper (one year on parts and labor) as Citizen's coverage (two years on parts and labor). So why buy a copy when you can get the original?

Texas Instruments 8930

by Karen Best

Texas Instruments' \$2,545 8930 is built for heavy-duty printing, particularly of multi-part forms. The 18-pin wide-carriage printer features a Z-Axis printhead controller that allows it to detect a form's thickness and adjust the printhead accordingly.

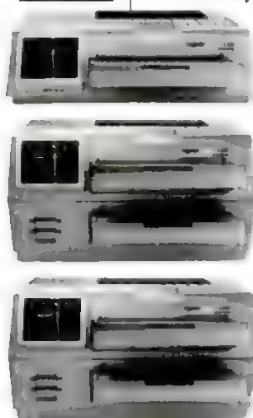
The 8930's paper-handling abilities don't stop there. Its Page Finder feature helps eliminate the misalignment of pages by sensing the right and left margins of a document, regardless of where the tractors are set or where the paper is inserted. It can

FONTS & FEATURES				
Tandy DMP 240				
Epson LQ				
	Bold	Italic	Sub/Supr	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

speed of 0.6 gppm, it worked well enough, but when we compared the initial results to the Citizen machine's, the Tandy output revealed white horizontal streaks. Changing the vertical setting largely eliminated the problem. So even though some users are skeptical of dot matrix color, we found the DMP 240 laid down solid enough colors for the charts and graphs of the small business user. If you decide you like the

The Okidata OK.TM
It's why we had
to re-invent
the laser printer.





What's the Okidata OK? It's a badge of honor that every Okidata product has to earn—a symbol of our commitment to design and deliver products that offer outstanding value and performance. Products that will not only satisfy you, but impress you.

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The performance promise behind the Okidata OK is the reason we had to re-invent the conventional laser printer. Our engineers frankly rejected the industry-standard page printer technology of laser beams, lenses and rotating mirrors. Instead, they designed and built a proprietary, solid-state LED printhead with no moving parts. It's a printing system so trouble-free, we guarantee our LED print element for 5 full years—making it by far the longest warranty in the industry.

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The OL400: The Only \$999 Page Printer.

Our 4 ppm OL400, for example, has the lowest list price of any page printer on the market: only \$999.* Yet that price gets you a printer that earned a PC Magazine Editor's Choice Award, with standard features—extra fonts, a full 200-sheet paper tray—that you won't find on a LaserJet® IIP selling for hundreds of dollars more. Plus a slim, low-profile design that's less bulky on a desktop.

The OL800: Twice the Output, with Room to Grow.

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The OL820: Smarter Than a LaserJet III.

The OL820 earned the Okidata OK by learning how to do font-scaling on the fly. Thanks to a special chip our engineers designed into the 820, it can solve complex type-sizing and positioning problems instantly—problems the LaserJet III needs to talk to its software to work out. That means the OL820 can deliver up to three pages of sophisticated text while the LaserJet III is still working on its first page.

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The OL840: PostScript and Beyond.

And for applications that require full Adobe PostScript® compatibility, our OL840 delivers it in spades. It's ready to connect to any PC or Macintosh® system, or to both at the same time—then switch between systems with the push of a button.

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Optional second paper tray available on OL800, OL820, and OL840 models.
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PC EDITOR'S CHOICE

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CIRCLE 170 ON READER SERVICE CARD

PRINTERS

DOT MATRIX

also sense the top of a form, and has a zero tear-off feature.

You load paper into the 52-pound, 11.1- by 25.4- by 13-inch (HWD) 8930 through its front vertical-path paper feeder. Also available are a 120-sheet single-bin cut-sheet feeder (\$359) and a 120-sheet second bin (\$249). The 8930's paper-parking feature allows you to feed a single form or other cut-sheet paper without having to disengage the tractor feed.

Paper parking is executable from the printer's easy-to-use control panel, which features a two-line, 16-character LCD display and membrane buttons. You can adjust the display so that it presents messages in English, French, German, or Spanish.

The 8930's fonts print in 10 cpi, 12 cpi, and compressed; all can be enhanced with boldfacing, italics, sub- and superscripts, and underlining. You can purchase additional fonts from TI in the form of user-installable ROM kits. Its \$89 Office Font Kit includes Presentor and Prestige Elite, and its \$149 Machine Readable Font Kit includes OCR-A and OCR-B as well as

Fonts & Features

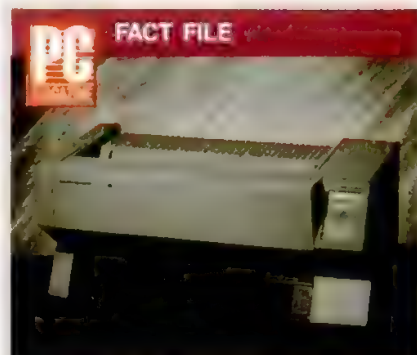
Texas Instruments 8930

	Epson FX			
	Bold	Italic	Sub-Super	Underline
10 cpi				
12 cpi				
Compressed				
Proportional				

several bar code fonts.

The three resident emulations are TI's 880/855 (with TI 857 color commands), Epson FX (with JX color commands), and IBM Proprinter XL. With the color ribbon installed, the printer can print up to seven colors.

The 8930 performed well on our speed tests, but did have one problem: when you send a command to the printer, there is a 3.6-second delay before it prints, which slowed down our test results. The reason for this delay is that when the printer finishes printing a page, it pops up the page a bit so the user can easily tear off the sheet. As the printer pauses, it counts down from ten to zero and displays these numbers on its LCD screen. When it is ready to print again, the 8930 pulls the paper back down into its carriage. Texas Instruments created this delay to give users some indication that the printer was going to start printing again. By the time this article is published,



Texas Instruments 8930

Texas Instruments Inc., P.O. Box 202230, Austin, TX 78720-2230; (800) 527-3500; 214-995-3333.

List Price: \$2,545; font kits, \$89-\$149; RS-422 interface kit, \$130; automatic sheet feeder, \$359; second-bin attachment, \$249; top feed tray, \$79; stand-mounted basket, \$75; printer-mounted basket, \$60; printer stand, \$160.

Standard Warranty: One year return to factory.

Dimensions (HWD): 11.1 x 25.4 x 13 in.

Weight: 52 lbs.

Emulations: Epson FX/JX, IBM Proprinter, Texas Instruments 880/855.

In Short: The 8930 is a versatile 18-pin printer that can handle multi-part forms and high-volume jobs with ease. Distinguished by its Z-axis printhead controller, which allows the printer to sense the thickness of forms and adjust the printhead accordingly.

CIRCLE 882 ON READER SERVICE CARD

Texas Instruments will have released a firmware upgrade that will allow you to enable or disable this feature.

Even with the delay, the Texas Instruments 8930 is fast. In our two-page dot matrix tests, we clocked the printer at 174 cps in draft mode under the Epson FX emulation, and at 61 cps in letter-quality mode under the same emulation. In our 20-page laser-printer tests, which minimize the effect of the paper-raising delay, the 8930 printed at 208 cps in draft. The print quality of both text and graphics is good, with letter-quality text approaching that of 24-pin printers.

In our color graphics tests, the 8930 had some difficulty emulating the Epson JX-80. Every time we ran the printer under this emulation, we received an Escape Sequence Error message, which happens when "the printer has received unrecognized escape commands," according to the 8930's manual. Still, the printer was able to complete our tests, printing our test graphics in 0.8 gppm.

Overall, the Texas Instruments 8930 is a dependable printer that can handle tough jobs well. With speed, good output quality, and intelligent paper- and multipart forms-handling on its side, the 8930 has a lot to offer you.

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printer



The award-winning KX-P1124.

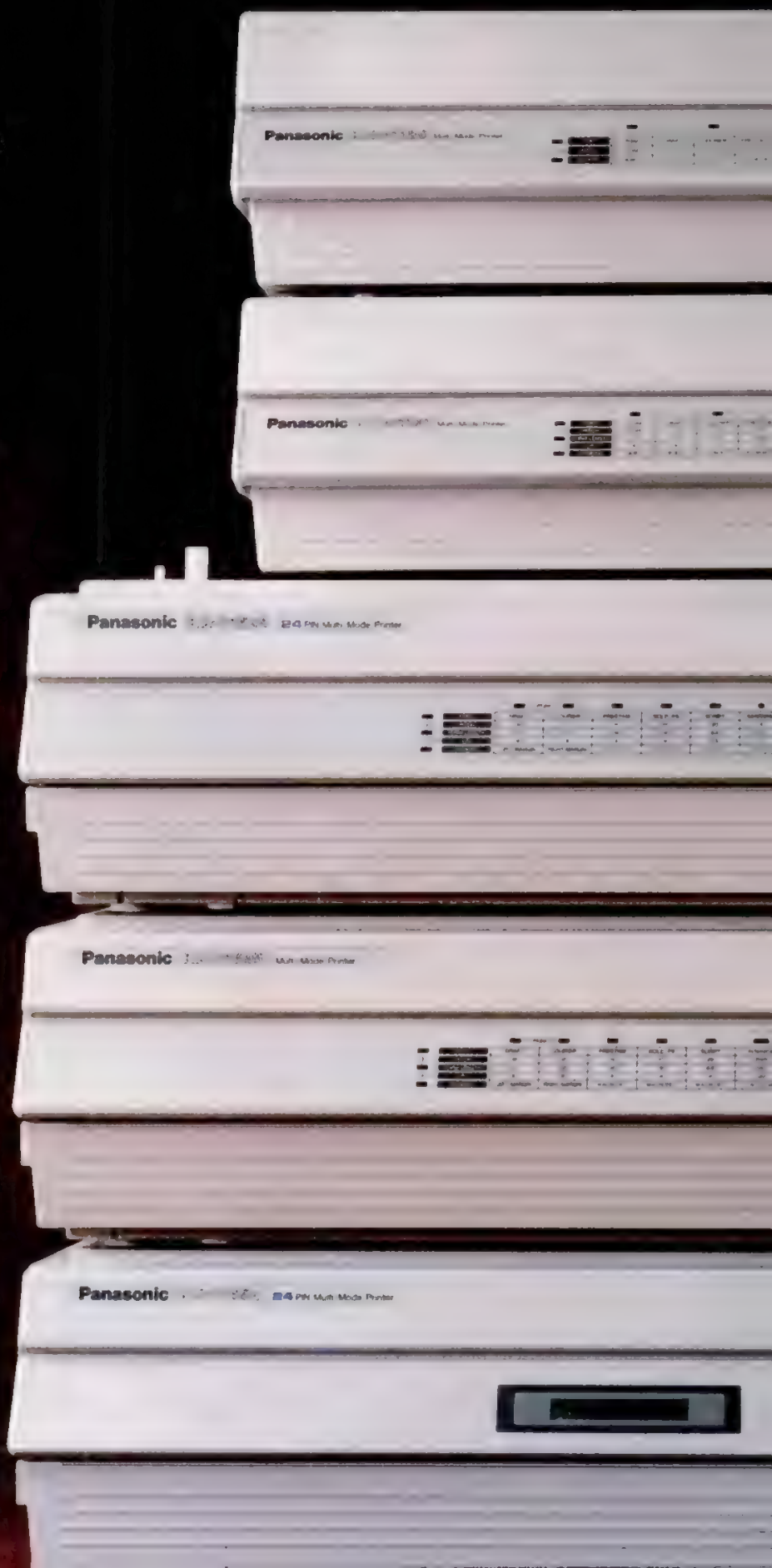
after another,

after another,

after another,

after another,

after another.





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And we've just introduced what may well be the quintessential office printer for the 90's, the KX-P1654. A wide-carriage 24-pin that rockets along at up to 375 characters per second. With print quality approaching that of lasers.

Chances are, your first Panasonic printer will lead to another, and another, and another.

For further information on Panasonic Dot Matrix Printers, see your Panasonic dealer, or telephone toll-free 1-800-742-8086.

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CIRCLE 138 ON READER SERVICE CARD

DMF-PC



INDEX TO PRINTER REVIEWS (1984-1990)

In the seven-year history of *PC Magazine's* printer project, we've tested and reviewed 713 PC printers. Today, 301 of them are still available from the manufacturers and are included in this index. For each printer, we've listed its type (daisy wheel, dot matrix, laser, or whatever), the current price, and the result of PC Labs' text speed test. To help you find everything you need to know about each printer, we've included the volume, issue, and page number of the original review.

PC Labs' text speed test hasn't changed since 1984, allowing you to compare speeds across the

seven annual printer issues. Note that from 1986 on, laser printer speeds have been measured in pages per minute (ppm). Dot matrix speeds have always been measured in characters per second (cps). To convert between the two measurements, remember that 4 ppm is about 267 cps.

For detailed evaluations of the 121 new printers we tested this year, see the reviews that precede this index. For quick comparisons of output and test results, see the *PC Magazine* Printer Guide that precedes each section of reviews.

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
A								
Advanced Matrix Technology	AMT Accel-535	CDM	161 cps	\$1,485	8	19	345	
AEG Olympia	NPC 136-24	CDM	96 cps	\$1,049	8	19	345	
AEG Olympia	NP 136-24	DM	118 cps	\$799	8	19	246	
AEG Olympia	NP 30	DM	93 cps	\$299	6	19	329	
AEG Olympia	NP 80-24	DM	115 cps	\$599	8	19	246	
AEG Olympia	NP 80-24E	DM	105 cps	\$499	9	19	334	613
AEG Olympia	NP 80SE	DM	126 cps	\$499	9	19	334	614
AEG Olympia	NP 136SE	DM	145 cps	\$699	9	19	334	614
AGFA	P3400 PS	L	10.5 ppm	\$12,500	8	19	117	
ALPS	ASP1600	DM	59 cps	\$299	9	19	339	615
ALPS	Allegro 500	DM	113 cps	\$499	9	19	345	616
ALPS	Allegro 500XT	DM	138 cps	\$799	9	19	345	616
Apple	LaserWriter HNT	L	6.4 ppm	\$4,499	7	18	116	
Apple	LaserWriter HNTX	L	6.8 ppm	\$5,999	7	18	116	
Apple	Personal LaserWriter NT	L	3.9 ppm	\$3,299	9	19	152	399
AT&T	477	CDM	144 cps	\$1,995	5	19	232	
AT&T	570	DM	124 cps	\$695	8	19	250	
AT&T	583	CDM	94 cps	\$842	8	19	348	
Axonix	LiteWrite	DM	50 cps	\$449	8	19	326	
Axonix	ThinWrite 100	DM	60 cps	\$499	6	19	255	
B								
Brother	HL-4	L	3.8 ppm	\$1,495	9	19	155	400
Brother	HL-8e	L	7.4 ppm	\$2,895	8	19	118	
Brother	HL-8PS	L	7.4 ppm	\$4,495	8	19	120	
Brother	HR-40	DW	31 cps	\$899	6	19	380	
Brother	M-1109	DM	53 cps	\$299	5	19	146	
Brother	M-1809	CDM	83 cps	\$627	8	19	350	
Brother	M-1824L	CDM	121 cps	\$749	8	19	352	
Brother	M-1909	CDM	129 cps	\$699	9	19	345	617
Brother	M-1924L	CDM	122 cps	\$949	9	19	346	618
Brother	M-2518	DM	123 cps	\$1,295	7	18	240	
Brother	M-4018	DM	258 cps	\$1,795	6	19	260	
Bull	Compuprint 4/22	DM	117 cps	\$499	9	19	348	619
Bull	Compuprint 4/23	DM	116 cps	\$699	9	19	348	619

■ =Editor's Choice, C=color, DW=daisy wheel, DM=dot matrix, IJ=ink jet, L=laser, TT=thermal transfer

PRINTERS
PRINTER INDEX

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Bull	Compuprint 4/24	DM	113 cps	\$995	9	19	351	620
Bull	Compuprint 4/40	CDM	154 cps	\$1,245	9	19	351	621
Bull	Compuprint 4/43	DM	142 cps	\$1,995	9	19	352	622
Bull	Compuprint 4/54	CDM	165 csp	\$1,995	9	19	357	623
Bull	Compuprint 4/68	CDM	192 cps	\$2,545	9	19	358	624
C								
Canon	BJ-10e	IJ	40 cps	\$499	9	19	276	669
Canon	BJ-130	IJ	68 cps	\$1,095	7	18	243	
Canon	LBP-4	L	3.9 ppm	\$1,545	9	19	156	401
Canon	LBP-8 Mark III	L	7.3 ppm	\$2,995	8	19	124	
Canon	LBP-8 Mark IIIR	L	7.4 ppm	\$3,795	9	19	165	402
Canon	LBP-8 Mark IIIT	L	7.5 ppm	\$3,295	9	19	165	402
CIE America	C-815	DM	195 cps	\$2,195	6	19	268	
CIE America	CI-1000	DM	388 cps	\$9,995	9	19	364	667
CIE America	CI-4000 Triprinter	DM	247 cps	\$2,195	7	18	250	
CIE America	CI-5000	DM	250 cps	\$1,995	9	19	358	625
Citizen	GSX-140	CDM	94 cps	\$499	9	19	361	626
Citizen	HSP-500	CDM	151 cps	\$499	8	19	357	
Citizen	HSP-550	CDM	156 cps	\$699	8	19	357	
Citizen	200GX	CDM	108 cps	\$299	9	19	360	627
C-Tech	C-310 XP	DM	157 cps	\$739	5	19	174	
C-Tech	C-315 XP	DM	150 cps	\$919	5	19	174	
C-Tech	C-510	DM	111 cps	\$639	9	19	368	629
C-Tech	C-515	DM	110 cps	\$749	9	19	368	629
C-Tech	C-610 Plus	DM	113 cps	\$799	9	19	368	630
C-Tech	C-610C Plus	CDM	112 cps	\$859	9	19	368	630
C-Tech	C-645	DM	168 cps	\$1,395	9	19	371	631
C-Tech	C-715A	DM	145 cps	\$1,499	6	19	267	
C-Tech	ProWriter C-240	DM	113 cps	\$449	9	19	365	628
C-Tech	ProWriter C-245	DM	110 cps	\$559	9	19	365	628
C-Tech	ProWriter C-310 CXP	CDM	177 cps	\$829	6	19	270	
CTSI International	Infoscribe 800	DM	108 cps	\$2,275	6	19	167	
CTSI International	Infoscribe 1100	DM	102 cps	\$2,080	7	18	149	
CTSI International	Infoscribe 1400	DM	173 cps	\$2,585	7	18	255	
D								
Dataproducts	LZR 650	L	6.4 ppm	\$1,695	9	19	166	404
Dataproducts	LZR 2450 D	L	18.3 ppm	\$19,995	9	19	169	403
Dataproducts	8070 Plus	DM	250 cps	\$1,795	7	18	261	
Dataproducts	9030	DM	136 cps	\$649	9	19	372	632
Dataproducts	9044	CDM	104 cps	\$1,199	9	19	372	633
Datasouth	DS 180	DM	128 cps	\$1,395	3	23	223	
Datasouth	DS 220	DM	150 cps	\$1,695	3	23	226	
DCS/Fortis	DM1310	DM	93 cps	\$299	6	19	288	
DCS/Fortis	DM2210	DM	131 cps	\$449	8	19	268	
DCS/Fortis	DM2215	DM	132 cps	\$529	8	19	268	
DCS/Fortis	DM3215	CDM	125 cps	\$699	9	19	391	643
DCS/Fortis	DQ4110	DM	100 cps	\$499	8	19	270	
DCS/Fortis	DQ4210	DM	122 cps	\$589	8	19	273	
DCS/Fortis	DQ4215	CDM	100 cps	\$899	8	19	364	

■ =Editor's Choice, C=color, DW=daisy wheel, DM=dot matrix, IJ=ink jet, L=laser, TT=thermal transfer

PRINTERS

PRINTER INDEX

INDEX TO PRINTER REVIEWS (1984-1990)

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Desktop Systems	Desktop Laser Beam	L	5.6 ppm	\$1,995	8	19	126	
Digital Equipment Corp.	DEClaser 2100	L	7.5 ppm	\$2,695	9	19	232	611
Digital Equipment Corp.	DEClaser 2200	L	7.6 ppm	\$3,999	9	19	232	611
Digital Equipment Corp.	LA 70 Personal Printer	DM	105 cps	\$499	9	19	376	634
Digital Equipment Corp.	LA 75 Companion Printer	DM	142 cps	\$835	9	19	375	635
Digital Equipment Corp.	LA 210	DM	138 cps	\$1,793	3	23	213	
Digital Equipment Corp.	LA 324 MultiPrinter	CDM	162 cps	\$2,095	9	19	377	636
Digital Equipment Corp.	LJ252 Companion Color Printer	CIJ	62 cps	\$1,780	9	19	276	673
Digital Equipment Corp.	LN03R AA	L	7.4 ppm	\$5,495	5	19	276	
E								
Eastman Kodak	Kodak Diconix 150 Plus	IJ	70 cps	\$519	8	19	327	
Epson	DFX-5000	DM	266 cps	\$2,199	7	18	267	
Epson	DFX-8000	DM	324 cps	\$3,699	9	19	380	637
Epson	EPI-4000	IJ	40 cps	\$1,999	9	19	284	670
Epson	EPL-6000	L	5.4 ppm	\$1,399	8	19	128	
Epson	FX-850	DM	138 cps	\$499	7	18	267	
Epson	FX-1050	DM	141 cps	\$699	8	19	260	
Epson	LQ-510	DM	82 cps	\$499	8	19	263	
Epson	LQ-850	DM	132 cps	\$749	9	19	383	638
Epson	LQ-860	CDM	128 cps	\$949	9	19	383	639
Epson	LQ-950	DM	128 cps	\$899	7	18	274	
Epson	LQ-1010	DM	81 cps	\$649	9	19	384	640
Epson	LQ-1050	DM	128 cps	\$1,099	9	19	383	638
Epson	LQ-2550	DM	138 cps	\$1,499	7	18	276	
Epson	LQ-2550	CDM	104 cps	\$1,499	8	19	362	
Epson	LX-810	DM	94 cps	\$299	8	19	266	
Everex Systems (Abaton Division)	LaserScript	L	5.9 ppm	\$2,995	9	19	179	406
F								
Facit	B1200	DM	74 cps	\$269	9	19	384	641
Facit	B2400	DM	111 cps	\$699	8	19	266	
Facit	B3100	DM	149 cps	\$749	6	19	284	
Facit	B3450	CDM	134 cps	\$1,249	9	19	386	642
Facit	B3550C	CDM	181 cps	\$1,499	8	19	363	
Facit	P6060	L	5.7 ppm	\$1,599	9	19	180	407
Fujitsu	DL3400	DM	143 cps	\$925	6	19	291	
Fujitsu	DL4400	CDM	121 cps	\$1,399	8	19	364	
Fujitsu	DL4600	CDM	169 cps	\$1,650	9	19	392	644
Fujitsu	DL5600	DM	230 cps	\$2,195	7	18	276	
Fujitsu	DX2300	DM	129 cps	\$645	6	19	292	
Fujitsu	DX2400	DM	157 cps	\$845	6	19	292	
Fujitsu	RX7100PS	L	5.1 ppm	\$3,995	8	19	142	
Fujitsu	RX7100PS Plus	L	5.3 ppm	\$3,790	9	19	184	408
Fujitsu	RX7100 S/2	L	5.3 ppm	\$1,395	9	19	184	408
Fujitsu	RX7300E	L	14.8 ppm	\$7,150	8	19	146	
G								
Genicom	1020	DM	111 cps	\$1,170	5	19	194	
Genicom	1040	CDM	103 cps	\$1,799	8	19	368	
Genicom	3320 Quiet	DM	144 cps	\$1,965	4	19	166	
Genicom	3410XLQ	DM	150 cps	\$2,175	8	19	273	

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PRINTERS

PRINTER INDEX

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Genicom	3820	DM	235 cps	\$2,475	8	19	280	
Genicom	3840	DM	241 cps	\$2,595	9	19	392	645
H								
Hewlett-Packard	DeskJet 500	IJ	62 cps	\$729	9	19	290	671
Hewlett-Packard	LaserJet III	L	7.5 ppm	\$2,395	9	19	184	409
Hewlett-Packard	LaserJet IIID	L	7.6 ppm	\$3,595	9	19	184	409
Hewlett-Packard	LaserJet IIP	L	3.9 ppm	\$1,495	8	19	152	
Hewlett-Packard	PaintJet	CIJ	78 cps	\$1,395	6	19	297	
Hewlett-Packard	PaintJet XL	CIJ	65 cps	\$2,495	9	19	290	672
Hewlett-Packard	RuggedWriter	DM	173 cps	\$1,695	7	18	280	
Hewlett-Packard	ThinkJet	IJ	70 cps	\$495	3	23	172	
Honeywell-Bull	Bull 4/66	DM	235 cps	\$2,395	6	19	302	
Howtek	Pixelmaster	CIJ	N/A	\$8,495	8	19	216	
I								
IBM	LaserPrinter	L	8.9 ppm	\$2,395	8	19	156	
IBM	LaserPrinter E	L	4.8 ppm	\$1,495	9	19	190	410
IBM	Proprinter II	DM	129 cps	\$449	6	19	304	
IBM	Proprinter II XL	DM	111 cps	\$579	7	18	282	
IBM	Proprinter III	DM	173 cps	\$599	7	18	285	
IBM	Proprinter III XL	DM	173 cps	\$799	7	18	285	
IBM	Proprinter XL24E	DM	159 cps	\$1,099	8	19	286	
IBM	Proprinter X24E	DM	100 cps	\$859	8	19	286	
IBM	Quickwriter	DM	192 cps	\$1,765	7	18	285	
IBM	Quietwriter Model 2	TT	28 cps	\$1,080	5	19	226	
IBM	Quietwriter III	TT	81 cps	\$1,815	6	19	312	
IBM	4216 Personal Pageprinter	L	5.6 ppm	\$4,999	7	18	150	
K								
Kyocera	F-1000A	L	9.4 ppm	\$2,895	7	18	152	
Kyocera	F-1800A	L	15.2 ppm	\$4,995	9	19	195	411
Kyocera	F-2010	L	6.8 ppm	\$4,295	6	19	188	
L								
Laser Computer	Laser 190E	L	90 cps	\$370	8	19	288	
Laser Computer	Laser 240	L	147 cps	\$600	8	19	290	
LaserMaster	LM 1000	L	N/A	\$7,495	9	19	211	612
M								
Mannesmann Tally	81	DM	73 cps	\$259	8	19	298	
Mannesmann Tally	85	DM	89 cps	\$569	5	19	164	
Mannesmann Tally	87	DM	113 cps	\$599	6	19	317	
Mannesmann Tally	90	IJ	101 cps	\$799	6	19	317	
Mannesmann Tally	130/9	CDM	131 cps	\$699	9	19	401	646
Mannesmann Tally	130/24	CDM	128 cps	\$899	9	19	402	647
Mannesmann Tally	131/9	CDM	120 cps	\$799	9	19	401	646
Mannesmann Tally	131/24	CDM	127 cps	\$999	9	19	402	647
Mannesmann Tally	222	DM	89 cps	\$999	7	18	291	
Mannesmann Tally	230/24	DM	108 cps	\$1,499	7	18	291	
Mannesmann Tally	290	DM	133 cps	\$1,299	5	19	208	
Mannesmann Tally	330	DM	190 cps	\$2,149	6	19	320	
Mannesmann Tally	340	DM	150 cps	\$2,349	7	18	292	

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And since it looks like the whole world is heading our way, you get over 2,100 SPARCware™ applications to choose from—including your favorite PC programs, like Lotus® 1-2-3®, WingZ®, Oracle®, and WordPerfect®.

In fact, since this system is such a great alternative to PCs, we're making it available through our expanded value-added dealer and reseller network, as well as our current channels. For even more

information on SPARCstation IPC, call 1-800-624-8999, ext. 2062.

And we'll show you a little something you'll never be able to add in to your PCs. It's called a future.



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PRINTERS

PRINTER INDEX

INDEX TO PRINTER REVIEWS (1984-1990)

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Mannesmann Tally	■ 490	DM	247 cps	\$3,399	5	19	250	
Mannesmann Tally	645	DM	313 cps	\$5,999	9	19	342	648
Mannesmann Tally	905	L	5.1 ppm	\$1,499	8	19	158	
Mannesmann Tally	906PS	L	5.8 ppm	\$3,495	9	19	196	412
Mannesmann Tally	910	L	9 ppm	\$3,995	6	19	197	
Mannesmann Tally	910 UPS	L	8.3 ppm	\$4,795	8	19	160	
Mitek Systems Inc.	130T	L	7.5 ppm	\$8,995	9	19	199	413
N								
NCR	6417-0101	DM	162 cps	\$600	9	19	406	649
NCR	6421-0201	DM	134 cps	\$1,050	9	19	407	650
NCR	6435	L	5.6 ppm	\$2,395	8	19	162	
NCR	6436-0501	L	3.8 ppm	\$9,450	9	19	200	416
NEC	Pinwriter P9XL	DM	157 cps	\$1,630	6	19	322	
NEC	■ Pinwriter P2200XE	DM	95 cps	\$399	8	19	298	
NEC	■ Pinwriter 5200	DM	138 cps	\$799	7	18	296	
NEC	■ Pinwriter P6200	CDM	144 cps	\$749	9	19	407	651
NEC	■ Pinwriter P6300	CDM	146 cps	\$999	9	19	407	651
NEC	Silentwriter LC 890XL	L	7.4 ppm	\$5,995	8	19	164	
NEC	■ Silentwriter2 90	L	5.8 ppm	\$2,495	9	19	205	414
NEC	Silentwriter2 290	L	7.4 ppm	\$3,995	9	19	208	415
NewGen Systems	TurboPS/360	L	2.1 ppm	\$4,995	9	19	220	417
NewGen Systems	TurboPS/480	L	2.1 ppm	\$7,495	9	19	220	418
O								
Office Automation Systems	LaserPro Express Series II	L	7.4 ppm	\$2,350	6	19	204	
Office Automation Systems	LaserPro Gold Express	L	7.2 ppm	\$3,495	7	18	154	
Office Automation Systems	LaserPro Silver Express	L	7.4 ppm	\$2,795	6	19	208	
Office Automation Systems	LaserPro 810	L	7.5 ppm	\$3,795	5	19	292	
Office Automation Systems	LaserPro 1510	L	13.5 ppm	\$6,350	7	18	156	
Okidata	Microline 172	DM	83 ps	\$289	8	19	299	
Okidata	Microline 182 Turbo	DM	94 cps	\$339	8	19	300	
Okidata	Microline 293 (Standard & IBM)	CDM	123 cps	\$839	5	19	174	
Okidata	■ Microline 320	DM	164 cps	\$499	7	18	300	
Okidata	■ Microline 321	DM	157 cps	\$699	7	18	300	
Okidata	Microline 380	DM	89 cps	\$449	9	19	414	652
Okidata	Microline 390	DM	144 cps	\$699	7	18	300	
Okidata	Microline 390 Plus	DM	140 cps	\$649	9	19	419	653
Okidata	Microline 391	DM	138 cps	\$949	7	18	300	
Okidata	Microline 391 Plus	DM	140 cps	\$949	9	19	419	653
Okidata	Microline 393	DM	170 cps	\$1,499	6	19	326	
Okidata	Microline 393 Plus	DM	167 cps	\$1,499	9	19	422	654
Okidata	Microline 393C	CDM	163 cps	\$1,599	7	18	302	
Okidata	OkiLaser 400	L	4.1 ppm	\$1,395	9	19	224	419
Okidata	OkiLaser 820	L	8.1 ppm	\$2,295	9	19	226	420
Okidata	OkiLaser 840	L	7.7 ppm	\$3,595	9	19	227	420
Okidata	■ Pacemark 2410	DM	216 cps	\$2,599	4	19	168	
Olivetti Office USA	DM105S	CDM	67 cps	\$399	9	19	422	655
Olivetti Office USA	DM309E	DM	144 cps	\$750	9	19	423	656
Olivetti Office USA	DM600S	DM	172 cps	\$1,895	9	19	426	657
Olivetti Office USA	PG 306	L	6.1 ppm	\$1,595	9	19	227	421
Output Technology Corp.	560DL	DM	147 cps	\$1,995	8	19	301	

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PRINTERS

PRINTER INDEX

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Output Technology Corp.	TriMatrix 850XL	DM	307 cps	\$2,495	6	19	330	
P								
Packard Bell	PB9500	L	5.7 ppm	\$2,195	9	19	228	422
Panasonic	KX-P1124	DM	87 cps	\$500	8	19	302	
Panasonic	KX-P1180	DM	59 cps	\$270	8	19	303	
Panasonic	KX-P1191	DM	35 cps	\$400	8	19	306	
Panasonic	KX-P1624	DM	96 cps	\$650	9	19	428	658
Panasonic	KX-P1695	DM	140 cps	\$700	9	19	428	658
Panasonic	KX-P4420 Laser Partner	L	7.4 ppm	\$1,695	9	19	235	423
Panasonic	KX-P4450i Laser Partner	L	10.2 ppm	\$2,095	9	19	236	424
Primages	Primage 90GT	DW	56 cps	\$1,500	6	19	386	
Printek	FormsPro 2000	DM	111 cps	\$2,095	5	19	247	
Printek	910 HT	DM	144 cps	\$1,425	3	23	214	
Printek	920 HT	DM	203 cps	\$1,895	3	23	253	
Printek	930	DM	111 cps	\$2,195	3	23	215	
Printronix	L1012	L	9.9 ppm	\$3,495	6	19	218	
Printronix	L2324 Report Expediter	L	20.9 ppm	\$15,500	8	19	167	
Printronix	P1013 Personal Line Printer	DM	99 cps	\$895	5	19	182	
Printware	720 IQ Laser Imager	L	6.7 ppm	\$11,990	6	19	221	
	with 1200 HD Image Processor							
Printware	720 IQ Professional II	L	7.5 ppm	\$11,990	9	19	240	425
Q								
QMS	ColorScript 100 Model 10	CTT	2.8 ppm	\$9,995	8	19	217	
QMS	ColorScript 100 Model 30	CTT	2.2 ppm	\$15,995	8	19	218	
QMS	PS-410	L	3.6 ppm	\$2,795	9	19	251	426
QMS	PS-810	L	6.7 ppm	\$3,995	7	18	165	
QMS	PS-810 Turbo	L	7.5 ppm	\$5,495	9	19	252	427
QMS	PS-820	L	6.9 ppm	\$4,995	8	19	172	
QMS	PS-820 Turbo	L	7.5 ppm	\$6,495	9	19	252	427
QMS	PS-1500	L	8.8 ppm	\$7,995	8	19	174	
QMS	PS-2210	L	17.3 ppm	\$11,995	9	19	256	428
Qume	CrystalPrint Express	L	2.6 ppm	\$5,595	9	19	242	429
Qume	CrystalPrint Publisher	L	5.1 ppm	\$3,495	8	19	176	
Qume	CrystalPrint Publisher II	L	5.2 ppm	\$3,995	9	19	245	542
Qume	CrystalPrint Series II	L	5.8 ppm	\$1,499	9	19	245	543
Qume	CrystalPrint Super Series II	L	6 ppm	\$1,999	9	19	246	544
Qume	CrystalPrint WP	L	5.8 ppm	\$1,395	7	18	173	
Qume	ScriptEN	L	8.2 ppm	\$3,495	7	18	174	
Qume	Sprint 11/55 Plus	DW	54 cps	\$1,295	3	23	340	
R								
Ricoh	PC Laser 6000	L	6 ppm	\$2,495	6	19	230	
Ricoh	PC Laser 6000/PS	L	5.3 ppm	\$4,495	8	19	181	
S								
Sanyo	PR-241	DM	111 cps	\$899	6	19	346	
Seikosha	BP-5460	DM	238 cps	\$1,999	8	19	307	
Seikosha	SBP-10AI	DM	314 cps	\$4,495	7	18	309	
Seikosha	SK-3000AI	DM	172 cps	\$649	6	19	349	
Seikosha	SK-3005AI	DM	170 cps	\$849	6	19	349	
Seikosha	SL-90	DM	63 cps	\$499	9	19	429	659

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Complete Systems... No U

Complete Systems Philosophy

MicroLab computers are renowned for their industry leading technology, performance and pricing.

We only sell complete systems. Monitors and hard disks are standard in every one.

Look closely. Some ads boast low cost "base" units primarily to attract your initial interest. Known as fly paper advertising, they serve only as a price starting point, often requiring a floppy disk or monitor to become a truly complete, functional system.

MicroLab customers are smart. They demand a bargain and a complete solution.

Plus they avoid sticky situations.

Custom System Configurations

Along the same lines, we realize that not every customer will want a fully loaded system. Least wise, not

the exact way we've configured it.

That's where our highly trained Systems Consultants come in.

Tell them you want a modem or tape back up installed off the bat and they'll lay out all your options.

Tell them you're a student on a budget and they'll help you configure a system that will economically suit your current needs while providing for future expansion.

Tell them you're really into CAD or Desktop Publishing and they'll drive home your many CPU, video, graphics controller and co-processor options.

Go ahead. Ask them. They especially love this part of their job.

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Each MicroLab system is hand assembled and put through a 72-hour battery of stringently administered

diagnostic tests. All to assure "bugs free" operation prior to shipment.

Your system is made in the U.S.A. and is shipped straight to you.

Fast. Direct. No middlemen.

And only the finest name brand, state-of-the-art components are used in each system we build.

No old technology or off-brand, low-cost "box stuffers" used here.

That's a promise. And a commitment!

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At MicroLab, we believe your system should look as good as it performs. So it's no wonder our customers applaud the unique, trendsetting two-tone styling of our system cabinetry.

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- 160MB Hard Disk Drive
- High Speed 1:1 Interleave
- Hard/Floppy Disk Drive Controller
- 14" Super VGA 1024x768 Monitor
- 16 Bit VGA Adaptor with 512K
- 2 Serial, 1 Parallel & 1 Game Port
- 101 Key Tactile Switch Keyboard
- MS-DOS 3.3 or 4.01

- 4MB RAM-expandable to 8 MB
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- 120MB Hard Disk Drive
- High Speed 1:1 Interleave
- Hard/Floppy Disk Drive Controller
- 14" Super VGA 1024x768 Monitor
- 16 Bit VGA Adaptor with 512K
- 2 Serial, 1 Parallel & 1 Game Port
- 101 Key Tactile Switch Keyboard
- MS-DOS 3.3 or 4.01

- 2MB RAM-expandable to 8 MB
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- 1.44MB 3.5" Floppy Disk Drive
- 80MB Hard Disk Drive
- High Speed 1:1 Interleave
- Hard/Floppy Disk Drive Controller
- 14" Super VGA 1024x768 Monitor
- 16 Bit VGA Adaptor with 512K
- 2 Serial, 1 Parallel & 1 Game Port
- 101 Key Tactile Switch Keyboard
- MS-DOS 3.3 or 4.01

Complete Super VGA

160MB System \$5195

Complete Super VGA

120MB System \$3245*

Complete Super VGA

80MB System \$2645

Video Options — Include Monitor & Video Card

MICROLAB 486 25 Price Matrix	Mon- ochrome 12"	Mon- ochrome 14"	CGA Color 14"	EGA Color 14"	VGA Color 14"	VGA Multi- Media 14"	VGA Hi-Res 14"
30MB 1:1 Interleave	\$1745	\$1795	\$1895	\$4045	\$4095	\$4145	\$4265
40MB 1:1 Interleave	\$1795	\$1845	\$1945	\$4095	\$4145	\$4195	\$4295
60MB 1:1 Interleave	\$1845	\$1895	\$1995	\$4145	\$4195	\$4245	\$4345
80MB 1:1 Interleave	\$1895	\$1945	\$2045	\$4195	\$4245	\$4295	\$4395
100MB 1:1 Interleave	\$1945	\$1995	\$2095	\$4245	\$4295	\$4345	\$4445
120MB 1:1 Interleave	\$1995	\$2045	\$2145	\$4295	\$4345	\$4395	\$4495
140MB 1:1 Interleave	\$2045	\$2095	\$2195	\$4345	\$4395	\$4445	\$4545
160MB 1:1 Interleave	\$2095	\$2145	\$2245	\$4395	\$4445	\$4495	\$4595
180MB 1:1 Interleave	\$2145	\$2195	\$2295	\$4445	\$4495	\$4545	\$4645

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Landmark, 114.1 - Norton 388

Video Options — Include Monitor & Video Card

MICROLAB 386 Cache 25 Price Matrix	Mon- ochrome 12"	Mon- ochrome 14"	CGA Color 14"	EGA Color 14"	VGA Color 14"	VGA Multi- Media 14"	VGA Hi-Res 14"
30MB 1:1 Interleave	\$1295	\$1345	\$1445	\$2495	\$2545	\$2595	\$2695
40MB 1:1 Interleave	\$1345	\$1395	\$1495	\$2545	\$2595	\$2645	\$2745
60MB 1:1 Interleave	\$1395	\$1445	\$1545	\$2595	\$2645	\$2695	\$2795
80MB 1:1 Interleave	\$1445	\$1495	\$1595	\$2645	\$2695	\$2745	\$2845
100MB 1:1 Interleave	\$1495	\$1545	\$1645	\$2695	\$2745	\$2795	\$2895
120MB 1:1 Interleave	\$1545	\$1595	\$1695	\$2745	\$2795	\$2845	\$2945
140MB 1:1 Interleave	\$1595	\$1645	\$1745	\$2795	\$2845	\$2895	\$2995
160MB 1:1 Interleave	\$1645	\$1695	\$1795	\$2845	\$2895	\$2945	\$3045
180MB 1:1 Interleave	\$1695	\$1745	\$1845	\$2895	\$2945	\$2995	\$3095

Makes a great LAN server or Multi-Tasking Workstation

• Optional mouse available • FREE MS-DOS 3.3 or 4.01

MS-DOS®, UNIX®, OS/2® & Novell® Compatible
Landmark 40.5.53.5 Norton 29.3.38.2

Video Options — Include Monitor & Video Card

MICROLAB 386 25 Price Matrix	Mon- ochrome 12"	Mon- ochrome 14"	CGA Color 14"	EGA Color 14"	VGA Color 14"	VGA Multi- Media 14"	VGA Hi-Res 14"
30MB 1:1 Interleave	\$1095	\$1145	\$1245	\$1995	\$2045	\$2095	\$2195
40MB 1:1 Interleave	\$1145	\$1195	\$1295	\$2045	\$2095	\$2145	\$2245
60MB 1:1 Interleave	\$1195	\$1245	\$1345	\$2095	\$2145	\$2195	\$2295
80MB 1:1 Interleave	\$1245	\$1295	\$1395	\$2145	\$2195	\$2245	\$2345
100MB 1:1 Interleave	\$1295	\$1345	\$1445	\$2195	\$2245	\$2295	\$2395
120MB 1:1 Interleave	\$1345	\$1395	\$1495	\$2245	\$2295	\$2345	\$2445
140MB 1:1 Interleave	\$1395	\$1445	\$1545	\$2295	\$2345	\$2395	\$2495
160MB 1:1 Interleave	\$1445	\$1495	\$1595	\$2345	\$2395	\$2445	\$2545
180MB 1:1 Interleave	\$1495	\$1545	\$1645	\$2395	\$2445	\$2495	\$2595

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MS-DOS®, UNIX®, OS/2® & Novell® Compatible
Landmark: 35.6 - Norton: 28.2

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ps. No Extras. No Kidding!

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Solid construction. Flexible design.

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All MicroLab systems come with operations documentation and are easy to use. Should you require personal assistance, our technical support team is staffed by trained, courteous Systems Engineers ready to help. Just a toll free call away.

And everyone knows (800) calls are costly. So when MicroLab decided to offer NATIONAL TOLL FREE technical support, some people thought us either gluttons for expense or confident our customers wouldn't have to use it too often.

We like to think we're just confident.

30 Day Money Back Guarantee

Your complete satisfaction is at the heart of every system we build.

So purchase your system with complete confidence. Put it through its paces. Kick the tires for 30 days.

If dissatisfied, simply contact us to initiate its expedient return and a prompt refund on the hardware price.

No questions. No hassles.

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MicroLab computers are rugged, solid performers built for compatibility and reliability.

We stand behind every system manufactured with a comprehensive 1 Year Limited Warranty on all required parts and labor.

Additionally, MicroLab offers its popular S.W.A.P. (Supplemental Warranty Assurance Program) Extended

Warranty Policy for additional warranty protection at a nominal price.

Be sure to ask your consultant for details.

MicroLab's Commitment

MicroLab is a wholly owned subsidiary of the National Microcomputer Research Institute, an organization dedicated to the advancement of microcomputer technology.

We've evolved into a preferred vendor for government, educational and corporate institutions alike.

We'd like nothing more than to be yours, too.

It's As Easy As Calling 1-800-677-7900

Whether you've got your eye on a pre configured MicroLab system or need assistance configuring one, call us today.

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MICROLAB™ 386/SX-16 & 386/SX-20



Next Day Service!

- 2MB RAM-expandable to 8 MB
- 1.2MB 5.25" Floppy Disk Drive
- 1.44MB 3.5" Floppy Disk Drive
- 65MB Hard Disk Drive
- High Speed 1:1 Interleave
- Hard/Floppy Disk Drive Controller
- 14" Super VGA 1024x768 Monitor
- 16 Bit VGA Adaptor with 512K
- 2 Serial, 1 Parallel & 1 Game Port
- 101 Key Tactile Switch Keyboard
- MS-DOS 3.3 or 4.01

MICROLAB™ 286/12



Next Day Service!

- 1MB RAM-expandable to 4 MB
- 1.2MB 5.25" Floppy Disk Drive
- 1.44MB 3.5" Floppy Disk Drive
- 30MB Hard Disk Drive
- High Speed 1:1 Interleave
- Hard/Floppy Disk Drive Controller
- Hi-Res Monochrome Monitor
- Monochrome Video Adaptor
- 2 Serial, 1 Parallel, & 1 Game Port
- 101 Key Tactile Switch Keyboard
- MS-DOS 3.3 or 4.01

MICROLAB™ XT/12



Next Day Service!

- 640KB RAM-expandable to 1MB
- 360KB 5.25" Floppy Disk Drive
- 30MB Hard Disk Drive
- Hard/Floppy Disk Drive
- Hi Res Monochrome Monitor
- Monochrome Video Adaptor
- Serial, Parallel & Game Ports
- 101 Key Tactile Switch Keyboard
- MS-DOS 3.3 or 4.01

Complete Super VGA 65MB System \$1995*

Video Options	Include Monitor & Video Card					
MICROLAB 386 SX 16 Price Matrix	Monochrome 12" 14" 16"	Monochrome Flat 14" 16"	EGA Color 14" 16"	EGA Color Color 14" 16"	VGA Multi 14" 16"	VGA Hi-Res 14" 16"
30MB 1:1 Interleave	\$1345	\$1395	\$1495	\$1645	\$1695	\$1845
40MB 1:1 Interleave	\$1395	\$1445	\$1545	\$1695	\$1745	\$1895
65MB 1:1 Interleave	\$1495	\$1545	\$1645	\$1795	\$1845	\$1995
80MB 1:1 Interleave	\$1795	\$1845	\$1945	\$2095	\$2145	\$2295
120MB 1:1 Interleave	\$1895	\$1945	\$2045	\$2195	\$2245	\$2395
160MB 1:1 Interleave	\$2295	\$2345	\$2445	\$2595	\$2645	\$2795
325MB 1:1 Interleave	\$2895	\$2945	\$3045	\$3195	\$3245	\$3395

MS-DOS®, UNIX®, OS 2® & Novell® Compatible
Landmark: 21/25.4 - Norton: 17.6/22.0

Complete Monochrome 30MB System \$995

Video Options	Include Monitor & Video Card					
MICROLAB 286 12 Price Matrix	Monochrome 12" 14" 16"	Monochrome Flat 14" 16"	EGA Color 14" 16"	EGA Color Color 14" 16"	VGA Multi 14" 16"	VGA Hi-Res 14" 16"
30MB 1:1 Interleave	\$995	\$1045	\$1145	\$1295	\$1345	\$1495
40MB 1:1 Interleave	\$1045	\$1095	\$1195	\$1345	\$1395	\$1545
65MB 1:1 Interleave	\$1145	\$1195	\$1295	\$1445	\$1495	\$1645
80MB 1:1 Interleave	\$1445	\$1495	\$1595	\$1745	\$1795	\$1945
120MB 1:1 Interleave	\$1545	\$1595	\$1695	\$1845	\$1895	\$2045
160MB 1:1 Interleave	\$1845	\$1895	\$2095	\$2245	\$2295	\$2445
325MB 1:1 Interleave	\$2545	\$2595	\$2695	\$2845	\$2895	\$3045

MS-DOS®, UNIX®, OS 2® & Novell® Compatible
Landmark: 16.1 - Norton: 13.4

Complete Monochrome 30MB System \$745

Video Options	Include Monitor & Video Card					
MICROLAB XT 12 Price Matrix	Monochrome 12" 14" 16"	Monochrome Flat 14" 16"	EGA Color 14" 16"	EGA Color Color 14" 16"	VGA Multi 14" 16"	VGA Hi-Res 14" 16"
30MB 1:1 Hard Disk	\$745	\$795	\$895	\$1045	\$1095	\$1245
40MB 1:1 Hard Disk	\$795	\$845	\$945	\$1095	\$1145	\$1295
65MB 1:1 Hard Disk	\$895	\$945	\$1045	\$1195	\$1245	\$1395
80MB 1:1 Hard Disk	\$1195	\$1245	\$1345	\$1495	\$1545	\$1695
120MB 1:1 Hard Disk	\$1295	\$1345	\$1445	\$1595	\$1645	\$1795

Landmark Speed Test: 13.4

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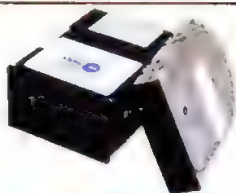


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Name Brand Products. Rock Bot

Hard Disk MicroKits



MicroLab Hard Cards



8 Bit Tandy SCSI 16 Bit

Hard Card/20	245	265	339	359
20MB, 40ms				
Hard Card/30	269	289	359	375
30MB, 40ms				
Hard Card/50	349	369	439	539
50MB, 40ms				
Hard Card/90	699	719	N/A	829
88MB, 15ms				

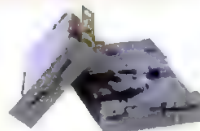
MicroLab Hard Cards are complete "plug 'n play" high performance hard disk sub-systems. The hard disk and controller card are mounted in-line on a slimline chassis. Mounted in any open bus expansion slot, the unit saves valuable drive bay space for other peripheral devices while minimizing overall system power consumption. 5 minute installation!

Floppy Disk Drives

TOSHIBA



MITSUMI



360KB Floppy	54
5.25", Black or Beige Bezel	
720KB Floppy	59
3.50", Black or Beige Bezel	
1.2MB Floppy	68
5.25", Beige Bezel	
1.44MB Floppy	69
3.50", Black or Beige Bezel	

Hard Disk Controllers

WESTERN DIGITAL CORPORATION



MFM Controllers

Western Digital XTGEN2PLUS	45
Dual Hard Disk Controller, 8-Bit, 3:1 Int	
Western Digital 1003VMM2	76
Hard/Floppy Disk Combination, 16-Bit, 2:1 Int	
Seagate ST22-M	79
Hard/Floppy Disk Combination, 16-Bit, 1:1 Int	
Western Digital 1006VMM2	89
Hard/Floppy Disk Combination, 16-Bit, 1:1 Int	

Western Digital 1004-A27X	45
Dual Hard Disk Controller, 8-Bit, 3:1 Int	
Seagate ST11-R	48
Dual Hard Disk Controller, 8-Bit, 3:1 Int	
Western Digital 1003VSR2	86
Hard/Floppy Disk Combination, 16-Bit, 2:1 Int	
Seagate ST22-R	89
Hard/Floppy Disk Combination, 16-Bit, 1:1 Int	
Western Digital 1006VSR2	99
Hard/Floppy Disk Combination, 16-Bit, 1:1 Int	

SCSI Controllers

Seagate ST-01	39
Dual Hard Disk Controller, 8-Bit, 3:1 Int	
Seagate ST-02	45
Hard/Floppy Disk Combination, 8-Bit, 3:1 Int	
Western Digital 7000FASST	299
Hard/Floppy Disk Combination, 16-Bit, 1:1 Int	

ESDI Controllers

Western Digital 1007VSE1	155
Dual Hard Disk Controller, 16-Bit, 1:1 Int	
Western Digital 1007VSE2	159
Hard/Floppy Disk Combination, 16-Bit, 1:1 Int	

Monitors



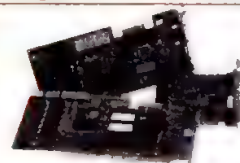
AOC
NEC



TTL Monochrome	65
12", Amber, 720x350, tilt/swivel base	
Amber Flat Screen	97
14", Amber, 720x350, tilt/swivel base	
Page White Flat Screen	99
14", Page White, 720x350, tilt/swivel base	
VGA Monochrome	119
14", Page White, 656x496, tilt/swivel base	
CGA Color	189
14", 640x240, tilt/swivel base	
EGA Color	275
14", 640x350, tilt/swivel base	
VGA Color	299
14", 720x400, tilt/swivel base	
VGA Multi-Scanning Color	369
14", 800x600, tilt/swivel base	
Super Hi-Res VGA	399
14", 1024x768, tilt/swivel base	
NEC 3D Super Hi-Res VGA	599
14", 1024x768, tilt/swivel base	

Video Graphic Boards

MaxLogic



ML/MGP	25
Monochrome graphic with printer port	
ML/CGP	28
Color graphic with printer port	
MaxLogic Auto EGA	79
EGA autoswitch, 256K RAM, 800x600	
Great Tek VGA	109
VGA, 16Bit, 256KB/512Exp. RAM, 1024x768	
ATI VGA Wonder/256	179
VGA, 16Bit, 256KB RAM, 1024x768, OEM	
ATI VGA Wonder/512	199
VGA, 16Bit, 512KB RAM, 1024x768, OEM	

MicroLab MicroKits Include

- Hard Disk Drive
- Dual Drive Controller for XT Kits
- Mounting Hardware
- Bezel & Cabling
- Disk Manager Software for Drives 40MB and Up
- Comprehensive Installation Manual

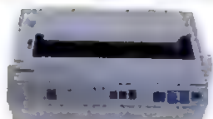


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Printers

Panasonic
Office Automation

star
MICROBONICS



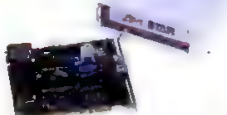
Panasonic 1180 192cps, 80 col., 9-pin	159
Panasonic 1191 240cps, 80 col., 9-pin	219
Panasonic 1124 192cps, 80 col., 24 pin	279
Panasonic 1624 192cps, 132 col., 24-pin	349
Panasonic 4420 Laser, 8pp. per minute, 22 fonts	899
Panasonic 4450i Laser, 11pp. per minute, 28 fonts	1299
Panasonic 4455 PostScript Laser, 11pp. per minute, 39 fonts	CALL
Star NX1000II 144cps, 80 col., 9-pin	159
Star NX1000 Rainbow 144cps, 80 col., 9-pin	199
Star NX1500 192cps, 132 col., 9-pin	279
Star XR1000 300cps, 80 col., 9-pin	299
Star XR1500 300cps, 132 col., 9-pin	409
Star XB2410 240cps, 80 col., 24-pin	429
Star XB2415 240cps, 132 col., 24-pin	549

Modems

CARDINAL
TECHNOLOGIES INC.

HYUNDAI

ZEM STAR

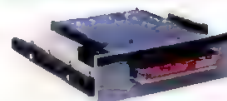


1200 Internal 1200/300 Baud Internal	47
2400 Internal 2400/1200 Baud Internal	75
2400 External 2400/1200 Baud External	89

All modems are Hayes compatible and come complete with user documentation. Internal models include terminal software.

Tape Back-Ups

COLORADO
MEMORY SYSTEMS INC.



Colorado 60 60/40MB Internal, half-height	245
Colorado 500 500MB Internal, half-height, w/host adapter	989

Tape Back-Ups come complete with data compression and back-up software. PS/2 Kit Add \$69. External Kits Add \$125. Tape Adapter Cards Add \$69.

Chips & Co-Processors

Intel



Intel 8087-3 5Mhz for XT systems	87
Intel 8087-2 8Mhz for XT systems	119
Intel 8087-1 10Mhz for XT systems	149
Intel 80287-6 6Mhz for 286 systems	119
Intel 80287-8 8Mhz for 286 systems	187
Intel 80287-10 10Mhz for 286 systems	209
Intel 80387-SX SX for 386 systems	279
Intel 80387-16 16Mhz for 386 systems	299
Intel 80387-20 20Mhz for 386 systems	349
Intel 80387-25 25Mhz for 386 systems	445
Intel 80387-33 33Mhz for 386 systems	549

*Ask for current DRAM, SIPP & SIMM pricing!

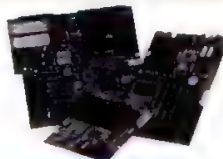
Mice & Software

Genius



Genius GM-6X 3 Button, 200-800 DPI w/Dr. Halo	20
Genius GM-6000 3 Button, 350 1050 DPI w/Dr. Halo	35
Genius GM-F302 3 Button, 350 1050 DPI w/Dr. Genius	47
Genius GeniScan 400 DPI, Bus Card w/Dr. Genius	159

System Componentry



Motherboards

ML/XT-12 4.77-12Mhz, Turbo Motherboard w/CPU	59
ML/286-12 12Mhz, 4MB EMS Motherboard w/CPU	129
ML/386-16SX 16Mhz, Near-SX Motherboard w/CPU	329
ML/386-20SX 20Mhz, Near-SX Motherboard w/CPU	499

ML/386-25 25Mhz Motherboard w/CPU	639
ML/386-25 Cache 25Mhz, 64KB Cache Motherboard w/CPU	799
ML/386-33Cache 33Mhz, 64KB Cache Motherboard w/CPU	999
ML/486-25 25Mhz, Cache Motherboard w/CPU	2499

All MicroLab Motherboards come with comprehensive user documentation and set-up utilities.

System Componentry



System Cabinetry

ML-XT Case & Power Supply XT Slide, Turbo/Reset Switches & Power, Disk and Turbo LED's plus 150W Power Supply	69
ML-Baby AT Case & Power Supply Baby AT, Turbo/Reset Switches & Power, Disk and Turbo LED's plus 200W Power Supply	89
ML-PS/2 Case & Power Supply PS/2, Slim Workstation, Turbo/Reset Switches & Power, Disk and Turbo LED's plus 200W Power Supply	95
ML-Mini Upright Case & Power Supply Mini Tower, Turbo/Reset Switches & Power, Disk and Turbo LED's plus 200W Power Supply	99
ML-Full Upright Case & Power Supply Full Tower, Turbo/Reset Switches & Power, Disk and Turbo LED's plus 230W Power Supply	175

MicroLab system cases are ergonomically styled, two-tone units and come complete with speaker, generous expansion parts supply and 4-lead power supplies.

FOCUS



Keyboards

Focus FK-2001 101-Key, true tactile "click" response, mechanical Alps switch, hinged dust cover/copy holder	49
Focus FK-3001 111-Key, true tactile "click" response, mechanical Alps switch, built-in solar-powered calculator	59
Focus FK-5001 130-Key, true tactile "click" response, mechanical Alps switch, built-in battery operated calculator, both top and left-side 12-key function key layouts, keyboard templates and holder, turbo switch	79

Add-On Cards

FDC-2 Dual Floppy Disk Controller	19
AT I/O Parallel, Serial & Game Ports	19
XT Multi I/O Dual Floppy Disk Controller, Clock-Calendar, Parallel, Serial & Game Ports	29
FDC-2 Multi Two FDC (360/1.2/720/1.44)	29
FDC-4 Multi Four FDC (360/1.2/720/1.44) Combo	39
XT High Density Multi I/O Dual Floppy Disk Controller, Clock-Calendar, Parallel, Serial & Game Ports	59

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PRINTERS

PRINTER INDEX

INDEX TO PRINTER REVIEWS (1984-1990)

Company name	Product	Type	Speed	Price	Vol.	No.	Pg.	Reader service number
Seikosha	SL230AI	DM	77 cps	\$1,999	8	19	307	
Seikosha	SP-2000	DM	86 cps	\$329	9	19	429	660
Siemens Information	Ink Jet PT 90-12	IJ	136 cps	\$1,500	8	19	309	
Siemens Information	PT 88S-32	DM	97 cps	\$718	8	19	312	
Star Micronics	LaserPrinter 8II	L	7.5 ppm	\$3,648	9	19	256	545
Star Micronics	NX-1000 Rainbow	CDM	67 cps	\$329	8	19	370	
Star Micronics	NX-1500	DM	91 cps	\$499	9	19	430	661
Star Micronics	NX-2410 Multi Font	DM	91 cps	\$399	9	19	436	662
Star Micronics	NX-2415 Multi Font	DM	100 cps	\$659	9	19	436	662
Star Micronics	XB-2410 Multi Font	DM	117 cps	\$749	8	19	313	
Star Micronics	■ XB-2415 Multi Font	CDM	110 cps	\$1,049	8	19	372	
Star Micronics	XR-1000 Multi Font	CDM	124 cps	\$499	9	19	435	663
Star Micronics	XR-1500 Multi Font	CDM	127 cps	\$799	8	19	313	
T								
Talaris	1590-T Printstation	L	11 ppm	\$9,990	8	19	187	
Tandy	DMP 107	DM	48 cps	\$280	8	19	314	
Tandy	DMP 133	DM	67 cps	\$380	8	19	316	
Tandy	DMP 240	CDM	98 cps	\$550	9	19	441	664
Tandy	DMP 300	DM	132 cps	\$649	8	19	316	
Tandy	DMP 442	DM	160 cps	\$699	8	19	317	
Tandy	DMP 2102	DM	136 cps	\$999	8	19	318	
Tandy	DMP 2130	DM	108 cps	\$1,199	9	19	438	665
Tandy	LP 1000	L	5.9 ppm	\$2,599	7	18	181	
Texas Instruments	885 Demand Document Printer	DM	195 cps	\$2,295	6	19	365	
Texas Instruments	880 AT	DM	172 cps	\$2,195	5	19	252	
Texas Instruments	8930	CDM	174 cps	\$2,545	9	19	441	666
Texas Instruments	microLaser	L	6.3 ppm	\$2,999	9	19	258	546
Texas Instruments	OmniLaser 2015	L	7.1 ppm	\$5,995	5	19	296	
Texas Instruments	OmniLaser 2108	L	7.4 ppm	\$5,995	6	19	232	
Texas Instruments	OmniLaser 2115	L	9.5 ppm	\$7,995	6	19	234	
Toshiba	ExpressWriter 301	DM	16 cps	\$489	8	19	328	
Toshiba	■ ExpressWriter 311	DM	73 cps	\$589	8	19	332	
Toshiba	PageLaser6	L	5.6 ppm	\$1,549	9	19	259	547
Toshiba	P321SL	DM	120 cps	\$799	6	19	370	
Toshiba	P321SLC	CDM	102 cps	\$949	7	18	331	
Toshiba	P341SL	DM	125 cps	\$949	6	19	370	
U								
Unisys	■ AP 1324	DM	117 cps	\$1,695	8	19	319	
Unisys	AP 1327	DM	124 cps	\$450	8	19	320	
Unisys	AP 9206	L	5.8 ppm	\$2,295	8	19	188	
Unisys	AP 9215-1	L	13.4 ppm	\$6,285	8	19	190	
Unisys	AP 9230	L	21.5 ppm	\$16,750	8	19	195	
Unisys	AP 9415	L	9 ppm	\$7,495	8	19	197	
V								
Varityper	■ VT600P	L	7.9 ppm	\$16,995	8	19	197	
X								
Xerox	4045 Laser CP Model 160	L	9.2 ppm	\$10,000	5	19	294	

■ =Editor's Choice, C=color, DW=daisy wheel, DM=dot matrix, IJ=ink jet, L=laser, TT=thermal transfer

Cocaine lies.

After nearly a decade of being America's glamour drug, researchers are starting to uncover the truth about cocaine.

It's emerging as a very dangerous substance.

No one thinks the things described here will ever happen to them. But you can never be certain. Whenever and however you use cocaine, you're playing Russian roulette.

You can't get addicted to cocaine.

Cocaine was once thought to be non-addictive, because users don't have the severe *physical* withdrawal symptoms of heroin—delirium, muscle-cramps, and convulsions.

However, cocaine is intensely addicting *psychologically*.

In animal studies, monkeys with unlimited access to cocaine self-administer until they die. One monkey pressed a bar 12,800 times to obtain a single dose of cocaine. Rhesus monkeys won't smoke tobacco or marijuana, but 100% will smoke cocaine, preferring it to sex and to food—even when starving.

Like monkey, like man.

If you take cocaine, you run a 10% chance of addiction. The

risk is higher the younger you are, and may be as high as 50% for those who smoke cocaine. (Some crack users say they felt addicted from the *first time* they smoked.)

When you're addicted, all you think about is getting and using cocaine. Family, friends, job, home, possessions, and health become unimportant.

Because cocaine is expensive, you end up doing what all addicts do. You steal, cheat, lie, deal, sell anything and everything, including yourself. All the while you risk imprisonment. Because, never forget, cocaine is illegal.

There's no way to tell who'll become addicted. But one thing is certain.

No one who is an addict, set out to become one.

C'mon, just once can't hurt you.

Cocaine hits your heart before it hits your head. Your pulse rate rockets and your blood pressure soars. Even if you're only 15, you become a prime candidate for a heart attack, a stroke, or an epileptic-type fit.

In the brain, cocaine mainly affects a primitive part where the emotions are seated. Unfortunately, this part of the brain also controls your heart and lungs.

A big hit or a cumulative overdose may interrupt the electrical signal to your heart and lungs. They simply stop.

That's how basketball player Len Bias died.

If you're unlucky the first time you do coke, your body will lack a chemical that breaks down the drug. In which case, you'll be a first time O.D. Two lines will kill you.

Sex with coke is amazing.

Cocaine's powers as a sexual stimulant have never been proved or disproved. However, the evidence seems to suggest that the drug's reputation alone serves to heighten sexual feelings. (The same thing happens in Africa, where natives swear by powdered rhinoceros horn as an aphrodisiac.)

What is certain is that continued use of cocaine leads to impotence and finally complete loss of interest in sex.

It'll make you feel great.

Cocaine makes you feel like a new man, the joke goes. The only trouble is, the first thing the new man wants is more cocaine.

It's true. After the high wears off, you may feel a little anxious, irritable, or depressed. You've got the coke blues. But fortunately, they're easy to fix, with a few more lines or another hit on the pipe.

Of course, sooner or later you have to stop. Then—for days at a time—you may feel lethargic, depressed, even suicidal.

Says Dr. Arnold Washton, one of the country's leading cocaine experts: "It's impossible for the nonuser to imagine the deep, vicious depression that a cocaine addict suffers from."

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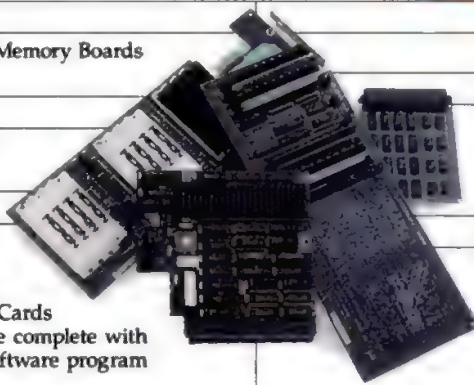
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by
Douglas Boling

Lab Notes

Intel's release of a new microprocessor every few years has become an eagerly awaited ritual. Since it is newer, faster, and more powerful, the Intel 80486 has become the must-have chip for the 1990s power user.

The 486 features a faster execution unit to speed processing of basic instructions, a redesigned interface to memory, and an integrated math coprocessor. All of these improvements combine to make the 486 the fastest and most powerful microprocessor of the 80x86 line.

Yet, for all its improvements in speed, the 486 is more of an evolutionary step than a revolutionary one. Unlike the 286 and 386 processors, the 486 does not extend the 80x86 line's basic architecture. Although the 486 chip does not contain any new modes—such as protected mode or Virtual 86 (V86) mode—its improvements nevertheless position the 486 to have a significant impact in a number of areas.

INTEGRATED FUNCTIONALITY

The integrated floating-point math coprocessor makes a 486-based machine an excellent choice for computation-intensive applications like CAD (computer-aided design) packages and spreadsheets using higher-math operations. Since the math coprocessor is included in the microprocessor itself, floating-point performance is much faster than a comparable 386/387 combination.

In earlier members of the 80x86 family, a processor and its companion math coprocessor communicate through a complicated protocol of I/O reads and writes. This protocol slows down both the processor and coprocessor, since each must wait for data from the other. Combining the processor and coprocessor allows data to be transferred as fast as it can move between two internal registers.

Intel did not stop with improving the floating-point performance. The 486 also includes a built-in memory cache unit to improve memory access times. The 8K memory cache not only stores recently

Bringing It All Together: A Look Inside The 486 Chip

■ The story behind Intel's latest achievement lies less in increased functionality than in the integration of existing strengths—cache, controller, and coprocessor—on a single chip.

used data, but it also anticipates future accesses by the processor by reading memory locations before the data there is actually needed.

To keep the cache full, the protocol with which the 486 reads memory has been redesigned for much greater efficiency. The 486 can use its burst mode to read large blocks of data at close to twice the speed of the 386. This is an important feature of the 486, but simply substituting a 486 in an old 386 system will not take advantage of the processor's high-speed burst mode.

Unfortunately, there is no way to determine whether a 486-based system is designed to use burst mode. Users interested in tapping this feature in a particular system should first check with its manufacturer to determine whether it uses the burst mode to read memory.

Another benefit of the 486 can be seen in the high integration of functions onto the chip itself. To provide the equivalent of the 486 using 386-type components, you would need a microprocessor, a floating-

point coprocessor, a memory cache controller, and the RAM chips that comprise the cache. Obviously, all these parts cost money and take up space. Even though the 486 is quite expensive (close to \$1,000 for a single 486), the cost of creating the same functionality from a 386 chip set can easily be higher.

Cost is not the only benefit of this high level of integration. Since the 486 chip is physically smaller than the combination of a 386 and 387, the 486 takes up less space on the motherboard. The space saved by the 486 can be used to add extra features, add more memory, or simply make the motherboard smaller.

ORIGINS OF THE 486

In order to gain a better understanding of the ideas behind the 486, it's helpful to take a look back at previous versions of the 80x86 family. All processors in the series are capable of running programs designed for the original 8086. A companion floating-point coprocessor, identified by an 80x87 number, is available for all versions except the 486.

The 8086, which was considered quite advanced for its day, pales in comparison with the 486. The 8086 and its sister chip, the 8088, have a slow four-cycle bus interface, can address only 1MB of memory, and by today's standards are quite slow. Crude as the 8086 appears these days, however, there's no overstating its contribution. The basic register set and architecture, after all, is still the core of every 80x86 processor.

The 8086's register set consists of four

Lab Notes

16-bit general-purpose registers, AX through DX. Another two registers, DI and SI, can be used as either index registers or general-purpose registers. A 16-bit flags register provides the current state of the processor.

Since all registers internal to the 8086 are only 16 bits wide, a set of four segment registers is used to provide base pointers for all addresses. During a memory access, the appropriate segment register is shifted 4 bits to the left and added to the offset of the instruction. This shift provides the 20 bits needed to address the 1MB of address space.

The 80186 and 80188 started with the core of the 8086 chip and added an internal timer and DMA channels. You won't find either of these chips serving as CPUs in many PCs, though, because these particular processors were designed more for the intelligent controller market than for the PC market.

Intelligent controllers are computers used for specific tasks. An Intel 8042 controller, for instance, is used in most PCs to control the keyboard. On many LAN adapter cards, 80186s are used to relieve the main processor from having to spend time with low-level network protocol.

The Intel 80286, first available in 1984, extended the 80x86 architecture to a new level of performance and functionality. The 286 includes a sophisticated memory management system to protect programs from interfering with one another. It can also address up to 16MB of memory, providing room for much more complex applications.

The major advance in the 286 was the addition of the processor's protected mode. When the 286 is in protected mode, its segment registers are used as pointers to memory tables instead of as base registers, as they are in the 8086. In a concession to backward compatibility, the 286 can be configured in real mode so that the segment registers are used as they are on the 8086.

When memory is addressed in protected mode, the 286 uses the appropriate segment register as a pointer into what's called a descriptor table. This table contains the actual base address of the segment as well as its size and access rights. The base address in the table is 24 bits wide, which allows the segment to be placed

anywhere within the 16MB memory space. And the access-right bits allow the 286 to protect segments from unauthorized reads and writes. Since reading a descriptor entry for each memory access is unacceptably slow, the 286 caches the last entry read for each segment register.

Protected mode is a vastly improved system of memory management over real mode. Unfortunately, the resulting loss of compatibility between real mode and protected mode has dealt the PC industry a blow from which it has yet to recover. The difference between real mode and protected mode is what allows OS/2 to use up to 16MB of memory. It also, however, is what prevents DOS applications from running under OS/2.

To provide compatibility, OS/2 pro-

**In simple terms, a
486 is a combination
microprocessor,
floating-point math
coprocessor, memory
cache controller, and
8K of RAM cache, all in
one chip.**

vides the DOS compatibility box—a part of OS/2 that executes in real mode and simulates the DOS environment. But because the 286 can run only one task at a time in real mode, the usefulness of the compatibility box is limited.

INDUSTRY EXPLOSION

The 80386 was the first processor of the 80x86 series that was designed after an explosion within the PC industry. While the 8086 and 80286 were 16-bit processors with 16-bit-wide registers, the 80386 *doubled* the bus width to 32 bits. The 32-bit data and address buses doubled the speed at which the processor could access memory. It also increased memory addressability to 4 gigabytes (4,096MB).

The 32-bit buses were not the 386's only attractive features. A paged virtual-memory scheme and the ability to simulate

multiple 8086 chips also increased the versatility of the 80x86 series. Another improvement was the removal of the 64K segment limit; this allowed segment sizes up to the entire 4GB address space.

Removing the segment size limit provides flexibility in how the 386 is programmed. For example, by making a segment start at address 0 and have a size of 4GB, the segment concept no longer has any significance. The OS/2 2.0 flat memory model is implemented in this manner.

For designs that prefer the protection of separate segments for different sections of code, the segment registers can be set as in the 286. Segments have the advantage that you can set them to specific sizes. If a program accesses memory outside of its segments, an error is reported to the operating system.

The 386's paged virtual-memory scheme has provided system programmers with an alternative to the segment-based, virtual-memory system of protected mode. Virtual memory allows an operating system to make it appear that applications have more memory available than actually exists in the system.

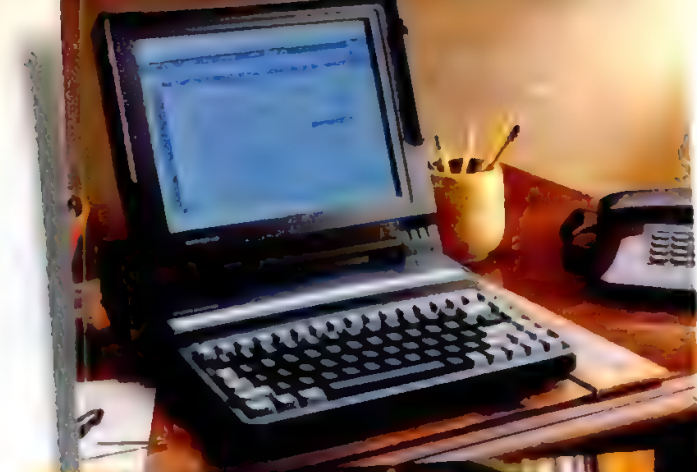
In a paged memory system, memory is divided into small portions of memory called pages (4K on the 386). As memory is accessed, the 386 checks a page table to see if the page requested is currently in memory. If it isn't, the processor interrupts the operating system to read that page of memory from disk.

While allowing the 286 version of protected-mode operation, an additional 386 mode called Virtual 86 (V86) mode allows the 386 to emulate multiple 8086 processors and, therefore, multiple DOS sessions. Using V86, software such as *Microsoft Windows 3.0* can run multiple DOS programs at the same time.

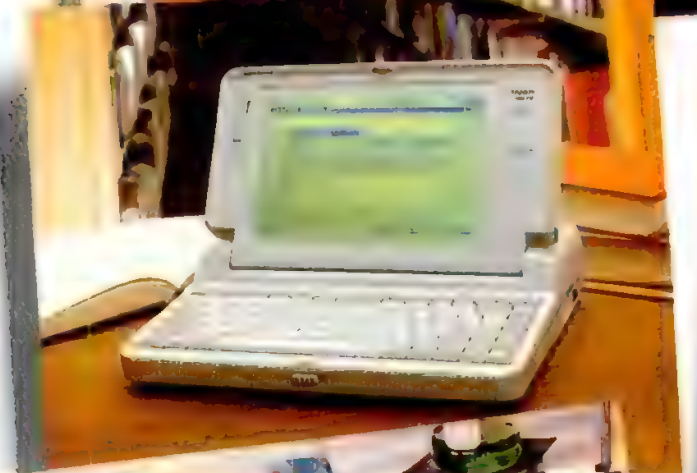
The registers of the 386 are 32 bits wide, but they retain their 8- and 16-bit addressability. Two new segment registers, FS and GS, were added to help in manipulating large numbers of segments. Four control registers are included to control and test the paged memory system. A set of debug registers is included to aid in program development.

80486 INTERNALS

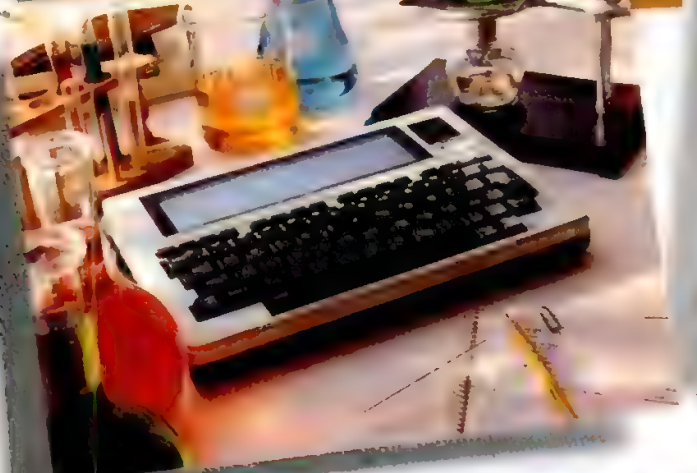
In simple terms, an 80486 is a combination of a microprocessor (80386), a floating-point math coprocessor (80387), a memory cache controller (82385), and 8K of RAM cache, all in one chip. Also included has been hardware for parity generation



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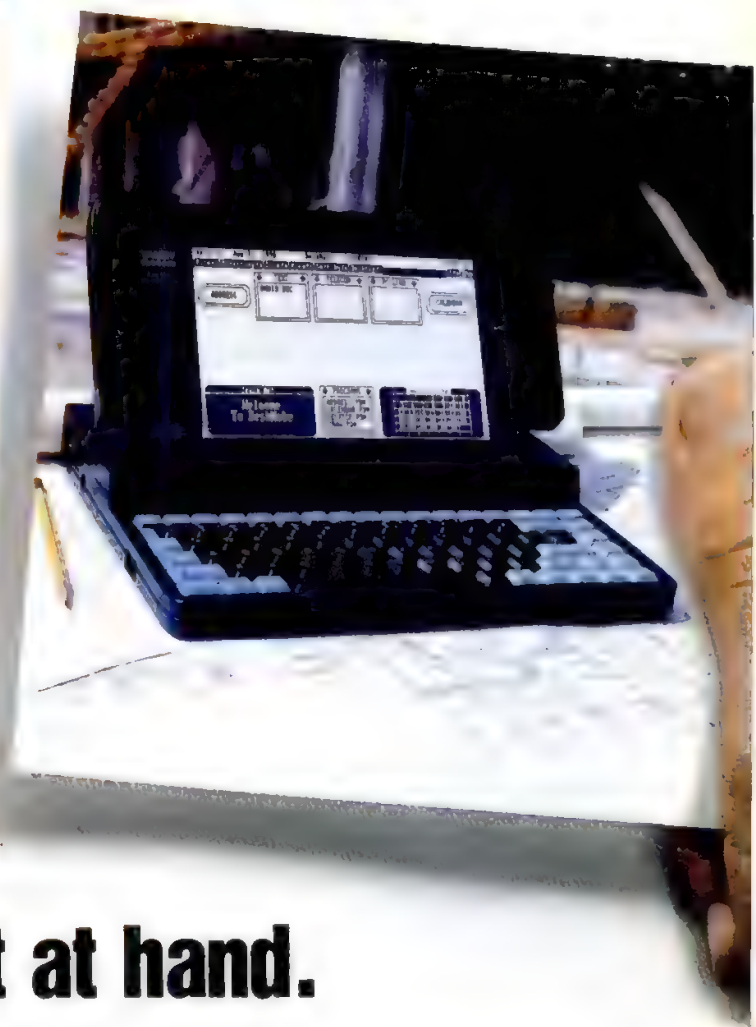


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Lab Notes

and parity checking. The speed improvements the chip makes were done by increasing the speed at which the 486 executes instructions, improving the speed at which the 486 talks to memory, and dramatically increasing the speed of the floating-point operations.

Software that takes advantage of the 387, you'll find, will run without modification using the 486. The reason? The 486's floating-point unit is completely compatible with the 80387.

Just as a 387 operates in parallel with the 386, the 486's floating-point unit operates in parallel with the Arithmetic Logic Unit (ALU). The ALU provides the function for all basic instructions such as moves, adds, and multiples; the floating-point unit implements all floating-point instructions. The two units operate independently of one another.

The 486's integral floating-point unit can read memory directly through the same bus interface that the ALU uses. Data is transferred between the general-purpose registers and the floating-point

unit on an internal 64-bit-wide data transfer bus.

The 486 can be configured to report floating-point errors in two different ways. The Intel-defined interrupt for reporting floating-point errors is INT 10h. (Note: this shouldn't be confused with INT 10h used for BIOS video routines in DOS systems.)

On DOS systems, a floating-point error is reported via the nonmaskable interrupt (NMI). The 486 can be configured either to perform an interrupt 10h automatically or to activate an external outside of the chip. For DOS systems, the 486 is configured to activate the external NMI hardware using the external floating-point error pin.

Aside from the integration of the coprocessor hardware, the 486 bus interface is the most functionally improved area. Dramatically boosting the performance of the 486 are enhancements to the local bus speed, the addition of a memory cache, and the close coupling of the cache to the instruction prefetch queue.

The local processor bus is the interface between the 486 and the outside world. Under normal operation the bus performs, as do the 286 and 386, with 2 clock cycles for every bus cycle. When a read requires

more than one bus cycle, however, the 486 can enter burst mode.

Under burst mode the 486 starts the bus cycle with the standard 2-cycle read, but subsequent reads are performed with only 1 clock cycle. For example, a 386 would take at least 16 clock cycles to read 32 bytes of data, whereas the 486 using burst mode could take as few as 9 clock cycles. Since the cache is filled by reading 16-byte blocks of data, burst mode has a major impact on the 486's performance.

INTERNAL CACHE

The 8K internal cache is organized in a four-way set associative fashion, each set consisting of four lines of 16 bytes. The cache is used in all memory reads whether the read is a data read or an instruction fetch. The 486 caches only memory reads; I/O reads are not cached. (For more on the 486 cache, refer to the sidebar "An 80486 Cache Primer.")

Caching can be controlled by disabling the cache entirely, disabling it on a memory-page level or using external hardware—at the bus-cycle level. External hardware can control the cache on a cycle-by-cycle basis using control lines on the 486. This allows system designers to tune

AN 80486 CACHE PRIMER

by Douglas Boling

One of the 80486's major improvements is the addition of an internal memory cache. To better understand how the 486 memory cache works, a quick review of caches in general might be helpful.

Caches improve performance by storing frequently used data in a quickly accessible place. In terms of the 486, reading data from a small cache memory inside the chip is much faster than reading from RAM on the motherboard.

When the 486 reads memory, the cache is first checked to see whether the required data is in the cache; if not, the memory is read and the data is placed in the cache. This way, when that data is required again, it can quickly be read from the cache.

When the correct data is found in the cache during a memory cycle, it is called a *hit*. If the data is not in the cache, the cycle is called a *miss*. The ef-

iciency of a cache is measured by its *hit rate*, which is calculated by dividing the hits (the number of times the correct data is found in the cache) by the total number of memory cycles. Intel claims a hit rate of around 90 percent for the 486's cache.

To be effective, a cache must quickly determine whether the data needed is in the cache. The 486 cache uses a Set Associative design to quickly locate data in the cache while providing efficient use of the cache memory.

In the Set Associative Cache, the cache is divided into *sets* of locations. System memory is divided such that only one set in the cache can hold data for a given location in memory. When the 486 attempts to read a location in memory, the cache looks in the set assigned to that location, to determine whether the data is in the cache. Since a set contains multiple locations in the cache, (four locations per set on the 486) the cache is efficient even if the

processor repeatedly reads from different memory locations assigned to the same set.

The 486 is a *write-through* cache. In a write-through cache, all data is written to memory even if the location to be written is in the cache. While this system is slower than if the write simply updated the cache, it ensures that the data in memory always matches the data in the cache.

The cache must deal with the problem of *stale data*. If another device, such as a DMA controller, writes to memory already contained in the cache, the data in the cache no longer represents the data in memory and thus becomes stale. The 486 recognizes this condition by monitoring whatever addresses are placed on the address bus when another device has control. This bus monitoring, known as *bus snooping*, allows the 486 to mark invalid any data in the cache that may not be accurate. ■

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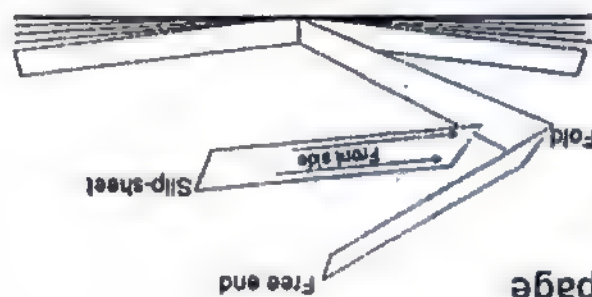
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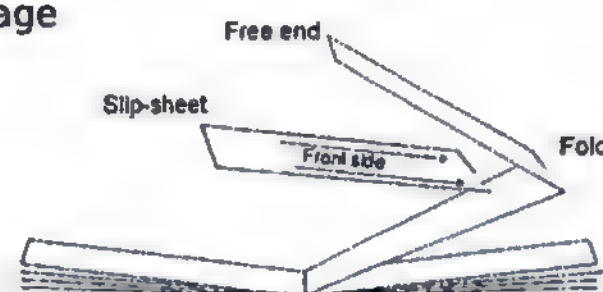
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4. Close the page and slip-sheet

Inverted Foldout slip-sheet



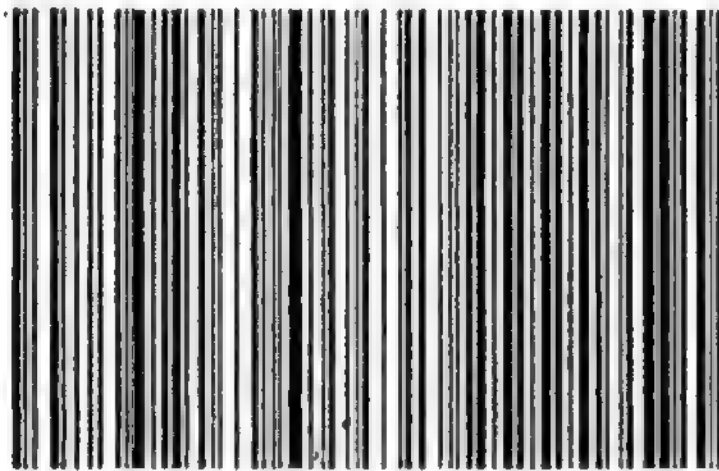
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



Gbs5lpBack-0018

Back

1. Follow instructions on the other side

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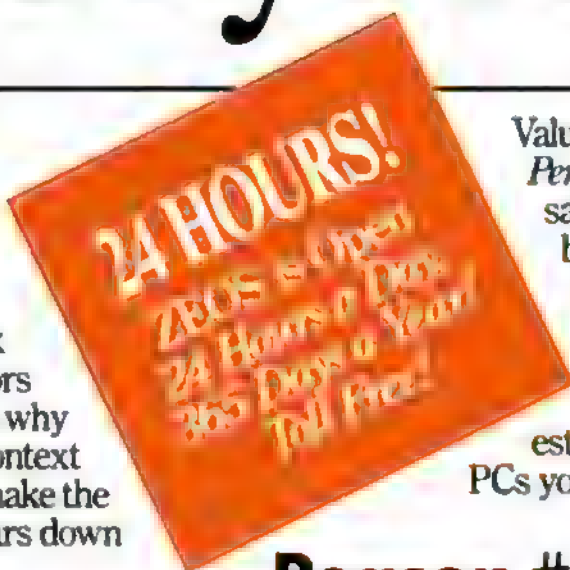
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Lab Notes

the 486's cache to achieve maximum performance.

If the bus is currently busy, memory writes are cached in one of four special write buffers. This write buffering allows the 486 to continue with the next instruction regardless of the state of the local bus. Since the write buffers delay the writing of data to memory, the buffers can cause

memory reads to occur before a write, even if the write were caused by a previous instruction.

Since the 486 can rearrange memory reads and writes, it would appear that problems could arise if the reordered instructions were working with the same address in memory. Thankfully, the 486 detects occurrences such as this and prevents problems by not allowing reordering in this case.

I/O writes are handled differently from memory writes. Single I/O writes are not

buffered, because of the problems this might cause with I/O devices. Multiple I/O writes are buffered but are always written in the same order as the instructions occurred.

Device recovery time between I/O accesses must be handled differently with the 486 than in previous versions of the 80x86 series. Programmers normally insert a jump instruction between I/O writes, allowing time for the I/O device to recover. On a 486 this method will not work, because the prefetch time may be dramatically reduced by the cache. On a 486, Intel recommends that a read to a noncacheable location should be inserted between I/O cycles to ensure device recovery time.

Another enhancement to the local processor bus is the addition of parity generation and checking for external data. Most PC compatibles use parity to check for memory errors. Before the 486, hardware on the motherboard generated and checked the parity bits. With the 486's integrated parity logic, the external parity logic can be eliminated.

When data is written, the 486 provides a parity bit for each byte of the data bus. The parity bit is stored along with the data byte in system RAM. When data is read, parity is checked for each of the valid data bytes. If an error is detected, the 486 simply sets an external pin; it is the responsibility of the system to act on the error. The parity logic is used to provide error checking for system RAM, not as an internal check of the 486.

NEW INSTRUCTIONS

Only six new instructions have been added to the 486 beyond the instruction set of the 386. The new instructions are

- Byte Swap
- Exchange and Add
- Compare and Exchange
- Invalidate Data Cache
- Write Back and Invalidate Data Cache
- Invalidate Translation Lookaside Buffer (TLB) Entry

The Exchange and Add (XADD) and Compare and Exchange (CMPXCHG) instructions combine the Exchange (XCHG) instruction with two of the most popular arithmetic instructions, ADD and CMP.

The Byte Swap instruction aids in converting long data from the big-endian to the little-endian formats. Intel processors store data larger than 1 byte with the lower-order byte in the numerically lower address; this is known as *little-endian* format. Motorola processors such as the 68000

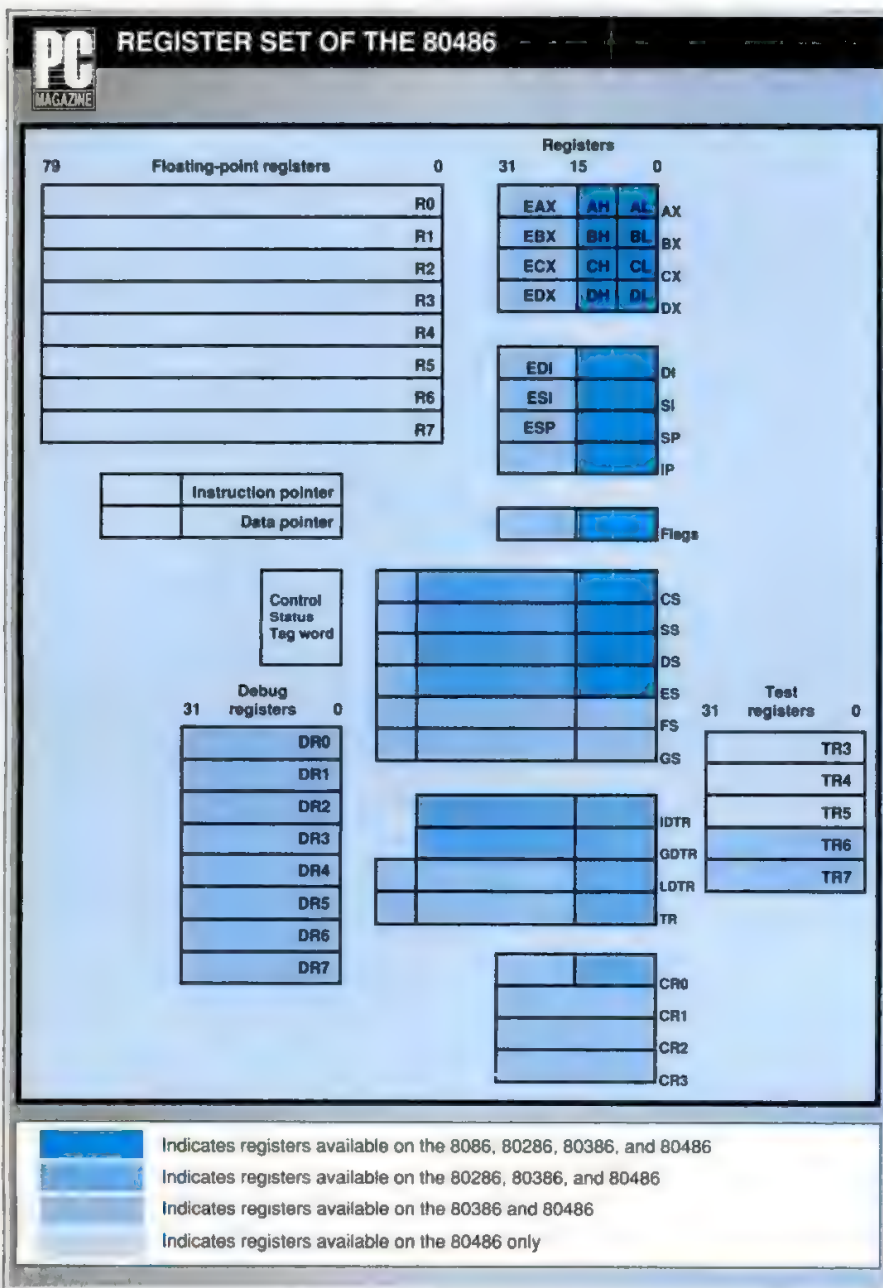


Figure 1: This diagram of the 80486's register set shows the processor's conglomeration of existing functions, including the integration of the 80387 floating-point math coprocessor's register set. The shaded areas indicate the register sets of previous Intel processors.

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Lab Notes

family store data in the *big-endian* format, with the lower-order byte in the higher address. While the Exchange (XCHG) instruction is useful for converting word values, the Byte Swap (BSWAP) instruction has been added on the 486 for conversion of double-word values.

The remaining three instructions are for cache manipulations and are not normally used by applications. The Invalidate Data Cache (INVD) instruction resets the cache. The Write Back and Invalidate Data Cache (WBINVD) instruction performs the same cache reset as the INVD instruction but also instructs any external cache to write to memory any write-cached lines. The Invalidate TLB Entry (INVLPG) instruction resets an entry in the page-table Translation Lookaside Buffer.

REGISTER SET

The true scale of the 80486 can be appreciated from a look at Figure 1, where all the functions of three major top-of-the-line Intel chips have been combined into one colossal processing unit: the 80486. In addition to the registers needed for 386/387 compatibility, additional registers have been added for testing the cache.

The registers of the 486 can be divided into three sets: the base architecture registers, the system-level registers, and the floating-point registers. The base architecture and floating-point registers are used by application programs, while the system-level registers are used by the operating system to control the memory management hardware, task switching, and internal cache.

The base architecture registers are identical to the registers on the 386. All registers are 32 bits wide but can be accessed as 16- and 8-bit registers for backward compatibility. The two additional segment registers added to the architecture with the 386—FS and GS—are included in the 486 as well.

The system-level registers consist of the control registers CR0 through CR3 and the segmentation base registers. While the control registers are backward-compatible with the 386, a number of new bits have been defined to control the new hardware included in the 486 processor. (For a detailed description of the new control register bits, read the sidebar "Control Register

Bit Assignments: 486 Versus 386.")

The floating-point registers are identical to the registers of the 80387. Eight 80-bit-wide data registers can be either directly addressed or configured as a stack. Each data register holds a 64-bit significand, a 15-bit exponent, and a sign bit.

The status word contains flags reflecting the status of the floating-point unit. The format of the status word, which contains the condition code bits from the last floating-point operation, is similar to that of the 387's status word. As on the 387, the instruction and data pointers are used to determine the cause of floating-point error exceptions.

486 I/O DESCRIPTION

The 486's hardware interface is similar to the 386's but is not pin-compatible. New control lines have been added for cache

control, memory-page control, parity generation, and burst-cycle control. The co-processor interface seen on earlier 80x86 processors has also been removed.

Figure 2 shows how the 486's hardware interface can be divided into sections denoting different functions, which don't necessarily correspond with the physical layout of the chip. As you can see, the address bus and bus control lines comprise the majority of the lines. Note also that the address bus lines are bidirectional, to accommodate the cache's need for "bus snooping."

Intel's commitment to compatibility is shown by the company's addition of a special line to control the Address bit 20 (A20) line. The larger address space of the 286 and 386 has an undesired effect on software written for the 8088's 1MB address space. Many software packages, including

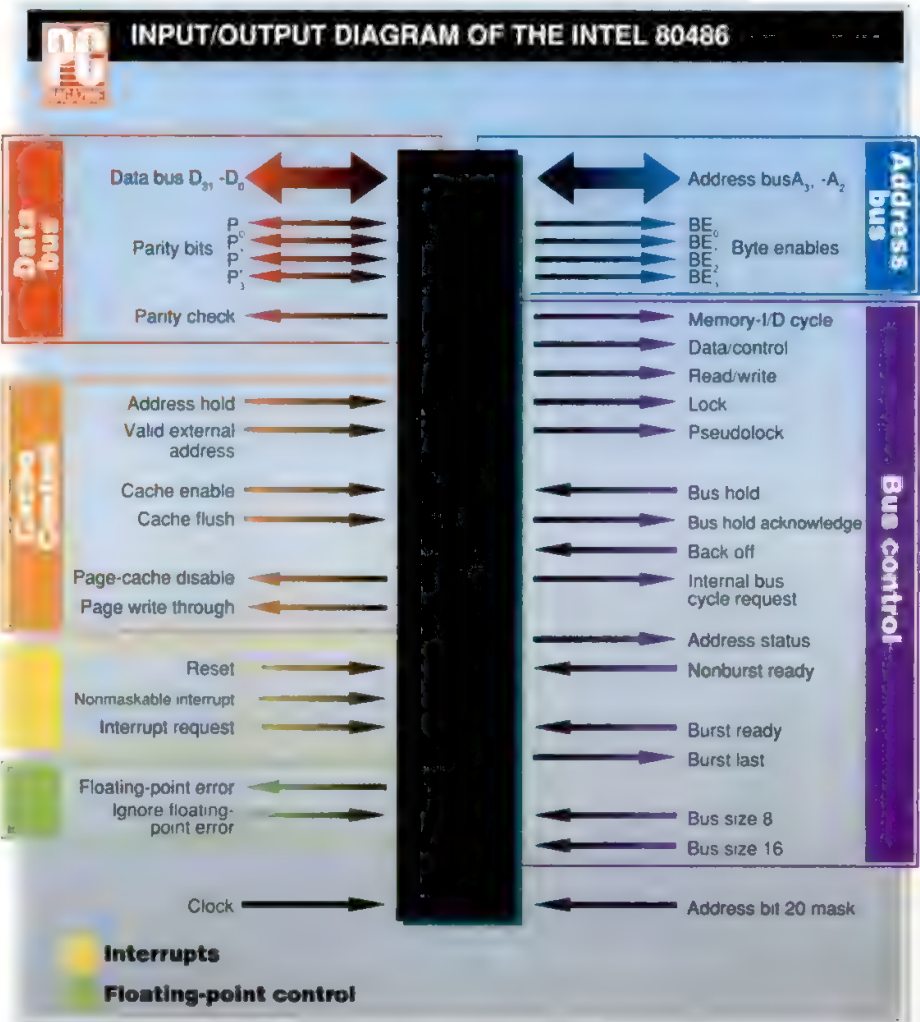


Figure 2: The 486's hardware interface is divided here into function-specific groups unrelated to the chip's actual physical layout. Arrows pointing toward the block represent inputs; those pointing away represent outputs. Arrows pointing both ways represent bidirectional pins.

Lab Notes

some versions of DOS, take advantage of the fact that, on the 8088, addressing past the 1MB limit simply wraps around to the lowest 64K of RAM.

To provide compatibility, 286 and 386 computers have special hardware external to the processor to allow the wrapping of addresses. Since the 486 has an internal cache, external hardware would not work. Therefore, the 486 includes a line to disable the A20 line internally. This internal

CONTROL REGISTER BIT ASSIGNMENTS: 486 VERSUS 386

by Douglas Boling

As you might expect, the integration of tasks once carried out by other chips has required an expansion of the 80486's register set in order to control the added functions. Here's a rundown of the differences in bit assignments between the 386 and 486. Figure 3 shows the 486's control register set.

The flags register format is bit-compatible with previous versions of the

80x86 family. The 486 uses the previously undefined bit 18 as a control for alignment checking.

If the alignment bit is set, the 486 will generate an interrupt when it accesses memory on a nonaligned memory address, such as accessing a word on an odd address or accessing a double word on an odd word boundary. If the 486 detects an alignment violation, it generates an interrupt 11h. Since PC-

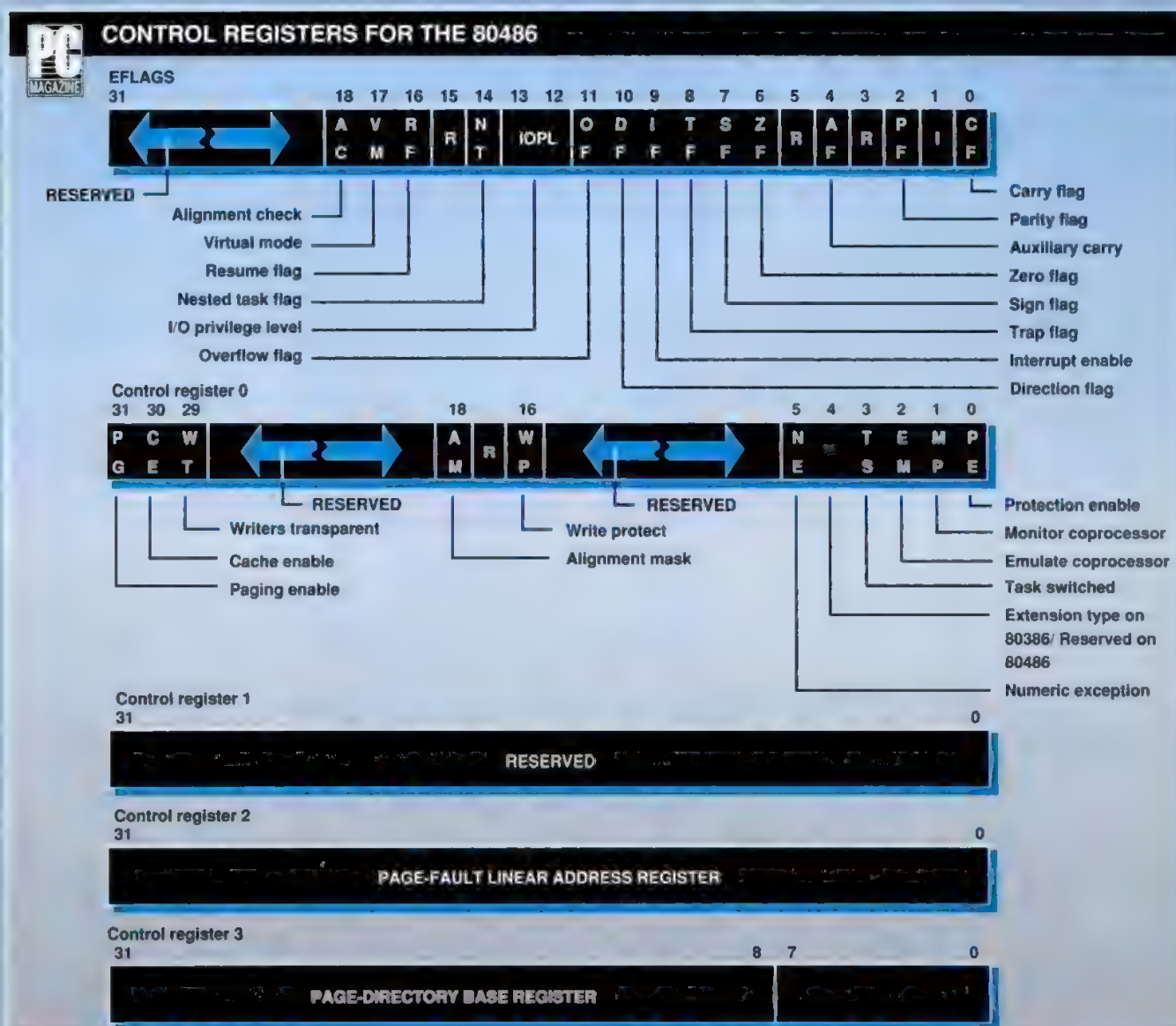


Figure 3: This diagram helps explain the differences in bit assignments between the 386 and 486. Bits marked R, reserved by Intel, include the Emulator Type bit, which let the 386 use a 287 or a 387 as a coprocessor. The 486's integrated floating-point coprocessor renders this bit unnecessary.

compatible machines use INT 11h for the equipment determination, any alignment-checking routine must check to see what brought about the INT 11h.

Five new bits have been defined in Control Register 0 (CR0) to handle the floating-point unit, the memory protection hardware, and the cache. The Alignment Mask bit (bit 18) is an additional control for the new alignment exception discussed above. This bit must be set, along with the AC bit of the Flags register, to enable alignment checking—it's necessary, since some older programs may accidentally modify the AC bit in the flags register.

The Numeric Exception bit (bit 5) determines how floating-point interrupts are handled. When the NE bit is set, floating-point interrupts are handled by generating the Intel standard interrupt 10h. When the NE bit is clear, floating-point errors are indicated by activating an external line. Clearing this bit allows a system to emulate the standard floating-point error handling used by IBM PC compatibles.

The Emulator Type bit (bit 5 in the 386) is not used by the 486. This bit allowed the 386 to use a 287 or a 387 as a coprocessor. Since the floating-point unit is included in the 486, this bit is not necessary. The Cache Enable (bit 30) and Write Transparent (bit 29) bits are the global control for the cache. These bits mask the state of the cache control bits, Cache Enable (CE) and Write Through (WT), in the page table entries.

The CE and WT bits are replicated in Control Register 0 (CR0) and in each page-table entry. For global control, bits can be set in CR0; for cache control at the memory-page level, bits can be set in the page-table entry.

CACHE CONTROL MODES

Control of the 486's cache is accomplished by setting the CE and WT bits into one of three allowable modes. The mode enabling the cache but disabling cache write-through, CE = 1, WT = 0, is invalid. If the 486 detects this combination, a general protection fault will occur. While this mode is illegal on the 486, Intel indicates that it may be allowed on future processors.

CE = 0, WT = 0 disables cache fills and cache invalidate cycles. Memory

reads that hit the cache in this mode, however, will still read from the cache instead of memory. To ensure that the cache is completely disabled, the cache must be flushed after it has been disabled.

CE = 0, WT = 1 disables cache fills but allows the cache logic to update the cache on memory write hits and invalidate cycles from other devices. This mode is useful when the cache is temporarily disabled, but the data in the cache must be kept accurate.

CE = 1, WT = 1 is the normal operating mode. In this mode the cache is filled on read misses and updated by write hits. All memory-write cycles, regardless of whether they hit the cache, are sent to the external bus.

Control register 1 is documented as *reserved* by Intel. CR 2 contains the 32-bit address that caused the last page fault, and CR 3 contains the set of the CE and WT cache control bits, which are used when a page table is invalid.

The 486 contains a set of eight debug registers (DR0–DR7), shown in Figure 1, that is similar to the set on the 386. One new bit has been defined in DR7 to extend protection of the debug registers against unauthorized access. When the Global Debug bit is set, any access to the debug registers causes an exception 1 interrupt. In other words, the bit allows debuggers full protection against programs that may attempt to use the debug registers.

In addition, three new test registers have been added to the 486 for testing the caching logic. The Cache Data Test Register (TR3) allows a test program to write and read data from the cache. The Cache Status Test Register (TR4) is used to test the control registers of the cache.

The Cache Control Test Register (TR5) is used to control the cache test operations. Five test operations can be performed on the cache: write to the cache, read from the cache, write the cache fill buffer, read the cache read buffer, and flush the cache.

Registers TR6 and TR7 provide testability for the page-table Translation Lookaside Buffer (TLB). The TLB is a cache used to speed operations using the page tables. The functions of these registers are similar to their functions on the 386. ■

wrapping of the address makes it possible for the cache to interpret wrapped addresses correctly.

The 486 differs from all previous 80x86 processors by specifying that the clock input must be the same speed as the processor. In other words, while a 25-MHz (megahertz, or millions of times per second) 80386 needed a 50-MHz clock, a 25-MHz 486 needs a 25-MHz clock. This may seem unimportant, but it can have an impact on the user. Here's why:

In order to achieve PC AT compatibility, many clones will slow down the clock of the computer any time the ISA (AT-compatible) bus is accessed. Many older ISA cards cannot respond quickly enough for today's high clock speeds. Slowing the clock speed when using the ISA bus allows older cards to operate as if they were in a slower system.

On a 486, changing the clock speed while the computer is running is not possible, because of the clock circuitry internal to the 486. While more-complicated methods of slowing bus cycles can be used, 486 systems cannot provide the tried-and-true method of slowing the clock speed for compatibility.

Some older software can also be affected by 486 systems' inability to slow down the processor. In some programs, timing loops dependent on the speed of the processor are used to measure time. Since the 486 runs much faster than previous 80x86 chips, the offending programs can become unusable. Fortunately, few if any programs today use such antiquated techniques as timing loops; a quick check of older software, however, is advisable before moving to a 486.

Is the 486 for everyone? In a word, no. While the improvements in speed are impressive, there are no extensions to the 80x86 architecture that can't be found in a 386-chip system. But if speed is the only consideration, the 486 is clearly your best route to the fast lane.

Already rumors abound concerning the 80586. And if the past is any gauge, the PC industry can surely look forward in anticipation to the next Intel 80x86 processor. But with more than one million transistors packed into one chip, let's take a breather and appreciate what cannot be overstated—that the 80486 is an incredible achievement of integration, speed, and power. ■

Douglas Boling is a contributing editor of PC Magazine.

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CIRCLE 477 ON READER SERVICE CARD



by
Richard Hale Shaw

Utilities

When contributing editor Michael J. Meford wrote his SMOOTH.COM utility ("Smooth Scrolling Means Easy Reading," Utilities, *PC Magazine*, February 14, 1989) he never intended for it to be run under *Microsoft Windows 3.0*.

Like many DOS programs, you can run SMOOTH under *Windows*; the utility even offers the same smooth scrolling, speed controls, and ease of use that it does on an EGA or VGA monitor under DOS. But SMOOTH was not designed to take advantage of the *Windows 3.0* GUI, and its behavior changes when you run it in a window. In fact, it takes some doing to run the DOS program in a window at all. You must either create a .PIF file for it or change its settings dynamically—in the Settings dialog selected from the System icon (the minus sign at the upper-left corner).

Passing it a command-line argument is the only way to tell SMOOTH what file to display. Once you've created an icon for it in a Program Manager Group, you must insert a filename in the command line of the Properties Dialog. Or else, you can type a "?" into the Optional Parameters slot in the .PIF Editor. *Windows* then will prompt you for a filename whenever you run the program. To display another file you have to either run another copy of SMOOTH or exit the first and start it again.

You'll find other idiosyncrasies that are common when running DOS programs under *Windows*. If you don't explicitly designate that it run in the background, for instance, it will freeze as soon as you move another program to the foreground. Of course, there's no mouse interface, so the scroll bars that appear are for moving around on SMOOTH's screen—not within the file.

You can terminate most *Windows* programs by double-clicking the System icon. But since SMOOTH is a DOS program, you'll have to go through several extra steps to terminate it with the mouse, provided you're in 386 enhanced mode. If you

WSMOOTH: Scroll Through Text Files Under Windows 3.0

■ Introducing WSMOOTH:
Our first *Windows* utility
whose keyboard/mouse
interface employs the best
of *Windows*' own video
technology to scroll files.

are, you can terminate SMOOTH by clicking the System icon and selecting settings, which in turn invokes a dialog box with an option for terminating the program. You can not terminate SMOOTH with a mouse if you're running in real or standard modes.

INTRODUCING WSMOOTH

Now there's a new version of SMOOTH written specifically for *Windows 3.0*—WSMOOTH. This utility is completely compatible with the three operating modes of *Windows 3.0*: real, protected, and 386-enhanced.

In addition to the keyboard interface provided by the original SMOOTH, WSMOOTH lets you use the mouse to navigate a file, control the scrolling speed, and select files for display. And because it's a full *Windows* program, WSMOOTH can use *Windows*' own video technology to scroll files in a window.

The easiest way to obtain a ready-to-use copy of WSMOOTH.EXE is to download it from PC MagNet, as explained in the sidebar "WSMOOTH by Modem." The source code files for WSMOOTH are listed here in the column. The code will also

be made available on PC MagNet, should you wish to modify and then assemble the program yourself.

Like the original SMOOTH for DOS, WSMOOTH lets you specify a filename and override the default settings by passing it command-line arguments. The syntax for this utility is

```
WSMOOTH [filename] [msecs] [pixel  
rows] [/W]
```

If you don't specify a filename, WSMOOTH will automatically invoke a file-selection dialog box. Once you've selected a file, WSMOOTH will begin scrolling the file in its window. The Up and Down Arrow keys set the scrolling direction, as does a single mouse click on the top or bottom of the vertical scroll bar. (Unless the right mouse button is specifically mentioned, all mouse clicks discussed refer to the left button.) PgUp and PgDn let you flip a screenful at a time, and Home and End move you to the top or bottom of the file.

It's easier to navigate a file via the mouse and the scroll bars. A press of the Spacebar or a single left mouse click in the text area will freeze the scrolling, and a subsequent keystroke or mouse click will resume the scrolling motion. When you're through, exit WSMOOTH by pressing Esc, selecting Exit from the File menu, or double-clicking the System icon.

The *msecs* parameter, a feature not found in the original version of SMOOTH, lets you set the frequency at which WSMOOTH scrolls the screen. By de-

Utilities

fault, *msecs* is set to 100 milliseconds, so it will try to scroll the text by the designated number of pixels, or approximately 10 times a second. A value of 1,000 will cause WSMOOTH to scroll about every second. I'm approximating these speeds because exactly how fast the screen scrolls also depends on how many other programs you're running under *Windows* and the speed of your computer.

The *pixel rows* parameter lets you adjust, from 0 to 9, the number of rows of pixels that are scrolled. The default value for this is 1. You can also control WSMOOTH's pixel scrolling on the fly in any one of three ways. First, you can use the numeric keypad's Plus and Minus keys to control the number of pixel rows scrolled at a time; hitting the Plus key will increase the number of pixel rows scrolled, while hitting the Minus key will decrease the number of pixel rows. A second method is to double-click and single-click the right mouse button, in order to increase and decrease the number of pixel rows scrolled, respectively.

Last, you can press one of the number keys; 0 brings WSMOOTH to a standstill, and numbers 1 through 9 increase the rate. You can use both the *msecs* (screen scrolling speed) and *pixel row* parameters to fine-tune WSMOOTH's scrolling. If you're running a number of *Windows* programs, you'll find that setting a higher (slower) scrolling speed will prevent WSMOOTH from taking too much time away from other *Windows* programs. If you simply want to leave WSMOOTH running in the background as it gradually pans through a file, a higher setting (1,000 or more) will also be better. But if you don't mind its affecting other programs you're running, set *msecs* to a very low value (like 5). This will let you run WSMOOTH at the highest possible scrolling speed.

You'll notice that WSMOOTH gets progressively less smooth as you increase the pixel-row setting. In fact, as the number of pixel rows being scrolled approaches the height of the default font, WSMOOTH's scrolling begins to resemble that of non-WSMOOTH programs. This is because non-WSMOOTH programs scroll by full line of text.

The /W switch causes WSMOOTH to strip the high bit from each character be-

fore displaying it. This feature proves useful when viewing *WordStar* (or other) files that use a character's high bit to format the document. If a document you're viewing with WSMOOTH occasionally displays graphics characters, try using this switch. By stripping the high bit from each character, WSMOOTH displays the intended characters.

Because WSMOOTH is
a *Windows* program,
you can move, resize,
and minimize or
maximize its window.
There are no
restrictions on what
kind of file you
can view.

Because WSMOOTH is a *Windows* program, you can move, resize, and minimize or maximize its window. There are no restrictions on what kind of file you can view; however, browsing non-ASCII text, such as executable files or word processor documents that include formatting commands, will normally produce a nonsensical display.

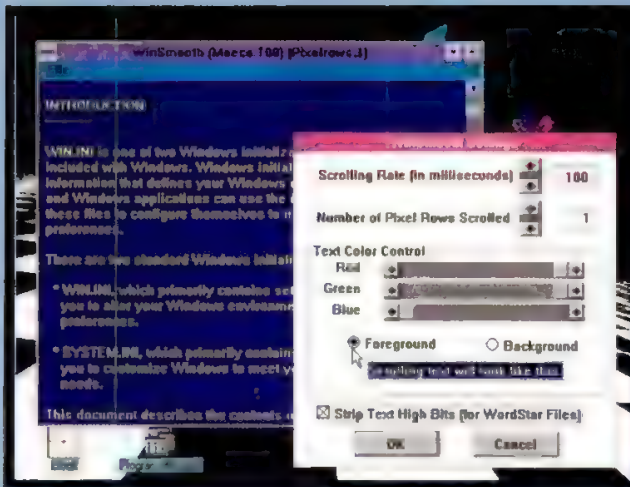


Figure 1: With this Settings dialog box, you can tailor WSMOOTH to meet your needs. It lets you adjust certain settings such as the frequency at which WSMOOTH scrolls the screen, the number of pixels rows that are scrolled at a time, and the screen color.

WSMOOTH's settings (*msecs*, pixel rows, /W, and the screen colors) can be set through the Settings dialog box shown in Figure 1. You can invoke it by selecting Settings from the File Menu. This dialog lets you tailor WSMOOTH to your needs while you're using it.

HOW WSMOOTH WORKS

To understand how WSMOOTH works, you should first be familiar with *Windows*' message-based, event-driven architecture. DOS programs are *proactive*. They take the initiative to find out what is going on; that is, they find out if a key has been pressed or the mouse has been clicked. *Windows* programs, conversely, are *reactive*; they wait for an event to happen and then react to it.

Here, for example, are the steps taken by a typical DOS application that supports the keyboard and the mouse:

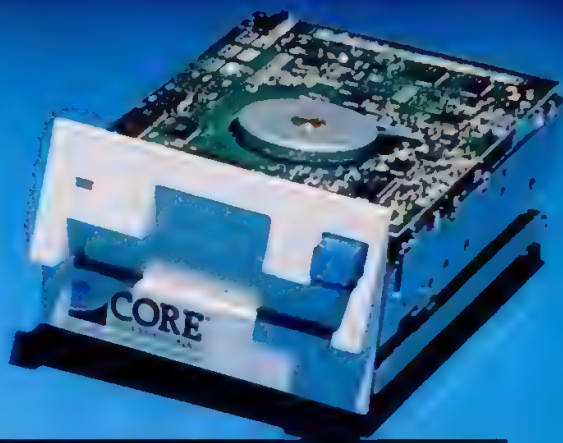
- (Beginning of loop.)
- Check the keyboard interrupt to see if a key has been pressed and, if one has, process the key.
- Check the mouse driver to see if a mouse click has been received.
- Execute another set of instructions.
- Return to beginning of loop.

Under *Windows* (and other GUI environments like the OS/2 Presentation Manager), the programmer writes instructions that instead say

- If a keystroke message is received, identify it and process it if it can be used.
- If a mouse-click message is received, identify it and process it if it can be used.

Under DOS, a program has to actively seek out input. *Windows* instead takes care of retrieving keystrokes, mouse clicks,

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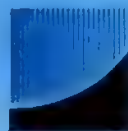
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Utilities

and other program input. It then sends a message with the input information to the program.

Windows places the messages destined for an application in the application's message queue. When the application retrieves a message, *Windows* calls the program's window-procedure to process the message. Once the application processes a message, it can get the next one. Thus, the real work of *WSMOOTH* is done in *MainWindowProc*, the program's own window procedure.

A *Windows* program receives a variety of messages while it's running, but it only needs to include code to handle messages appropriate to the program; it can ignore any others. *Windows* messages are 2-byte words, so a *Windows* program written in C can use a "switch" statement to decide what to do upon receiving a message. If the message matches one of the labels, the program executes the corresponding function. Otherwise the message has no effect.

Handling messages with a switch statement is the heart of *Windows* programming in C. It's easy to find the code corresponding to each message, and nothing happens that *isn't* triggered by a message. So *Windows* code is easier to maintain than standard C code. Also, rather than defining a new function or module to add a new feature, you may only need to add a re-

sponse for another message to your switch statement.

In some cases, these can be messages designed by the programmer that the application sends to itself. The importance of a

SLICE.COM, Version 1.3
SNIPPER.COM, Version 1.2
TPFST-AT.COM, Version 1.1
ZCOPY.COM, Version 1.2

For a complete list of all the programs available from the PC MagNet Utilities Database, download UDCAT.ARC.

A downloadable index to *PC Magazine's* product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine Reviews Index* for January, 1988, to June, 1990. This easy-to-use database is a subset of the *Computer Library Periodicals Database*, which is available on CD-ROM and on PC MagNet. It requires the search files in PCSRCH.EXE.

PCSRCH.EXE is a self-extracting archive containing the software used to retrieve citations from the *PC Magazine Reviews Index*. Please take the time to read the information file, named PCM.INF, before you download any of these files.

PC UTILITIES UPDATES

Like all good software, the programs presented in *PC Magazine* are upgraded and improved. The only way to obtain the modified versions is to download them from PC MagNet. Here is a partial list of the programs that have been upgraded to fix minor bugs and system incompatibilities:

ALIAS.COM, Version 1.1
ANSI.COM, Version 1.3
BAT2EXEC.COM, Version 1.2
BESS.COM, Version 1.3
CARDFILE.COM, Version 1.1
CHKFRAG.EXE, Version 1.2
CONFIG.CTL, Version 2.0
DIRMATCH.COM, Version 2.0
EMMA.COM, Version 2.1
EMS40.SYS, Version 1.1
LITES.COM, Version 1.1
LOG.COM, Version 1.1
PANDORA.COM, Version 1.4 (formerly PAN)
PCMANAGE.EXE, Version 1.1
PCREMOTE.COM, Version 1.1
RN.COM, Version 2.0

WSMOOTH

COMPLETE LISTING

```
#debugging options
#COPTIONS=-WX -W3 -c -DWINDOWS -DFILEBUF -AS -Gsw -Od -Ipiel
#LINKOPTS = /MOD /CO

#normal options
COPTIONS=-WX -W3 -c -DWINDOWS -DFILEBUF -AS -Gsw -Ox -Spe
LINKOPTS = /MOD

all: wsmooth.exe

wsmooth.res: wsmooth.rc wsmooth.h
rc -r wsmooth.rc
rc wsmooth.res

wsmooth.obj: wsmooth.c wsmooth wsmooth.h wsmooth2.h filebuf.h
cl $(COPTIONS) wsmooth.c

wsmooth2.obj: wsmooth2.c wsmooth wsmooth.h wsmooth2.h
cl $(COPTIONS) wsmooth2.c

file.obj: file.c wsmooth wsmooth.h wsmooth2.h
cl $(COPTIONS) file.c

filebuf.obj: filebuf.c filebuf.h wsmooth wsmooth.h wsmooth2.h
cl $(COPTIONS) filebuf.c

wsmooth.exe: wsmooth.obj wsmooth2.obj file.obj wsmooth.def wsmooth filebuf.obj
link $(LINKOPTS) wsmooth wsmooth2 file filebuf,, libw sliibcw, wsmooth.def
rc wsmooth.res
```

Figure 2: This is the Make file for WSMOOTH.

message queue and the role of the window-procedure will become more apparent in the discussion that follows. (For more on *Windows* programming, see *Programming Windows*, by contributing editor Charles Petzold, to be published this fall by Microsoft Press.) To investigate the program, consult the source code listings in Figures 2 through 11.

CREATING THE SCROLLING EFFECT

To create its continuous scrolling effect, *WSMOOTH* doesn't call a function over and over in a loop. Instead, it creates a *Windows timer*—a facility that a *Windows* program can use to generate a timer message, *WM_TIMER*, at specified intervals. If designed to do so, a program will assume that receipt of a timer message means an event should take place. Thus, upon receiving the appropriate timer message, *WSMOOTH* scrolls the window.

Windows doesn't guarantee that a program using a 1-second timer will receive a *WM_TIMER* message every second; *Windows*, after all, must divide its attention among *all* the programs running. In the case of a 1-second timer, *Windows* posts a

CONTINUES

Power Computing For The 90's?

A collage of computer-related puzzle pieces. The pieces are in various colors (blue, black, white) and shapes. One piece is labeled 'ISA', another 'DRAM', and a third shows a keyboard. There is also a piece with a 'PC MAGAZINE' logo and text: 'SEPTEMBER 11, 1990', 'NORTHGATE ELEGANCE', '486/25'. The background is white with a subtle grid pattern.

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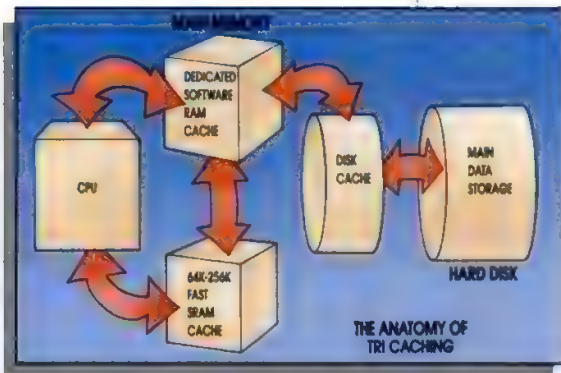
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A subsequent issue of *InfoWorld* (July 30, 1990) showed Elegance 486i leading the pack again as a network file server and stand-alone system as well.

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Elegance 486i ISA System Features

- ◆ 25MHz Intel® 80486 processor
- ◆ 4Mb of 32-bit RAM (expandable to 8Mb on motherboard; total system RAM of 16Mb with optional 32-bit memory card)
- ◆ Proprietary, U.S.-made motherboard
- ◆ 200Mb Maxtor hard drive with 15ms access; 16-bit controller with 1:1 interleave; 32K disk read-look-ahead cache buffer
- ◆ 64K SRAM memory cache; read/write-back caching
- ◆ High density 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives; also read/write low density disks
- ◆ Eight expansion slots; one 32-bit slot; six 16-bit and one 8-bit slot
- ◆ Weitek math coprocessor support
- ◆ One parallel and two serial ports
- ◆ High-resolution monochrome monitor
- ◆ Clock/calendar chip rated at 5 years
- ◆ 200 watt power supply (220 watt power supply in tower case)
- ◆ Desktop case with room for 3 exposed and 2 internal half-height devices
- ◆ Front mounted reset and high/low speed controls
- ◆ Exclusive Northgate *OmniKey*/ULTRA keyboard
- ◆ MS-DOS 4.01 and GW-BASIC software installed
- ◆ On-line User's Guide to the system and MS-DOS 4.01
- ◆ QA Plus Diagnostic and Utility software
- ◆ Microsoft Windows 3.0 and mouse
- ◆ 1 year warranty on system parts and labor; 5 years on keyboard
- ◆ Unlimited 24-hour toll-free technical support
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- ◆ FCC Class B Certified

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- ◆ Modems
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- ◆ SVGA color monitors and cards
- ◆ Weitek coprocessors

Northgate Elegance 386/33 System...

“...combines top performance, good components and aggressive pricing... excellent performer all around.”

PC Magazine
October 31, 1989



Award winning 386 performance! Sizzling Northgate Elegance 386/33 and 386/25 systems both won *PC Magazine* Editor's Choice awards, been rated #1 and #2 products (respectively) in *InfoWorld* AND received *Computer Shopper* "Best Buy" recognitions. No other company can make that claim! Here's how we did it!

Elegance 386's high performance motherboard is designed and manufactured by Northgate. With a 16Mb 32-bit DRAM capacity, it's consistently rated in the top 1% of performance — at 25 and 33MHz, Elegance 386 is the fastest in its class!

Tri-caching started here! Elegance was Northgate's first triple caching

machine. It comes with 64K read write-back SRAM cache to accelerate the execution of instructions. And, as your needs increase you can expand Elegance's SRAM to a Northgate exclusive 256K! A 32K hard drive cache controller accelerates I/O transactions while Smartdrive DOS disk caching software increases overall system throughput.

Zip through demanding programs. Multi-stage caching easily handles even a heavy overhead of video programs, I/O intensive tasks, network servers, large data bases and advanced desktop publishing programs.

Desktop or tower... your choice!

Elegance 386 comes standard in our elegant five bay desktop case. Our popular seven bay tower case is also available. Either way, you get plenty of room for all kinds of I/O boards, and internal/external peripherals.

Start with our base system! Northgate's base system includes 1Mb of RAM, a 40Mb fast access hard drive, 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives, a 14" high resolution monochrome monitor and our exclusive *OmniKey*®/PLUS keyboard.



Tell us what you need... we'll build your system! Performance options include: hard drive options up to 1.2 gigabytes with 15ms access; VGA and SVGA color cards and monitors; Intel and Weitek math coprocessors; CD ROM and optical drives; tape backups; printers and a host of others!

Or select our **Power System** with 4Mb of RAM, a 200Mb Maxtor hard drive with 15ms access, 1.2Mb 5.25" and 1.44Mb 3.5" floppies, a 14" Super VGA color monitor and an *OmniKey* keyboard. Comes complete with Microsoft® Windows™ 3.0, Samna®Ami™ Professional word processing software, Wingz™ graphics spreadsheet and database software and a mouse. This \$1139.00 suggested retail value software is yours at NO EXTRA CHARGE!

Elegance 386 Base System Features:

- 25 or 33MHz Intel® 80386DX processor
- 1Mb of 32-bit RAM (expandable to 8Mb on motherboard; total system RAM of 16Mb with optional 32-bit memory card)
- Proprietary, U.S.-made motherboard
- 40Mb fast access hard drive; 16-bit controller with 1:1 interleave; 32K disk read-look-ahead cache buffer
- 64K SRAM memory cache; read/write-back caching
- High density 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives; also read/write low density disks
- Eight expansion slots; one 32-bit slot; six 16-bit and one 8-bit slot
- Weitek math coprocessor support
- One parallel and two serial ports
- Hercules compatible video adapter
- Clock/calendar chip rated at 5 years
- 200 watt power supply (220 watt power supply in tower case)
- Optional seven bay upright Tower case; room for three exposed and four internal half-height devices or desktop case with room for three exposed and 2 internal half-height devices
- Front mounted reset and high/low speed controls
- Exclusive Northgate *OmniKey*/ULTRA keyboard
- 14" high resolution monochrome monitor
- MS-DOS 4.01 and GW-BASIC software installed
- On-line User's Guide to the system and MS-DOS 4.01
- QA Plus Diagnostic and Utility software
- 1 year warranty on system parts and labor; 5 years on keyboard
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Industry's finest 24-hour toll-free technical support! Your Elegance 386 is backed by expert technical support any time you need it. Call toll-free, 7 days a week, 24 hours a day. PLUS, free on-site next day service to most locations if we can't solve your problems over the phone.

Elegance 386 is backed by a one year warranty on parts and labor; five years on the *OmniKey* keyboard. If a part fails, we'll ship a replacement to you overnight at our expense — before you return your part!

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Power User's System \$4699⁰⁰

33MHz Base System Model

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Power User's System \$5199⁰⁰

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Northgate® Announces ...

SlimLine™ 386/25-



First time ever! Now you can have Northgate Elegance™ power, speed and performance in our popular space-saving SlimLine case! Elegance 386 computers shocked the industry with a #1 and #2 sweep of *Infoworld's* 1989 best product awards; AND three Editors' Choice awards from *PC Magazine*.

Cache! Cache! Cache! Like our powerful Elegance systems, SlimLine 386 features 64K SRAM cache to zip through the execution of instructions. For even faster speed, we've added a hard drive

cache to make quick work of I/O transactions. To top it off, SlimLine 386 comes with Smartdrive DOS disk caching software that anticipates the information you'll need next and brings it into the cache for fast access.

Better features across the board! SlimLine's motherboard is highly integrated, allowing maximum system features in the smallest possible space. It includes space for up to 8Mb of 32-bit RAM, one parallel and two serial ports, fully integrated floppy disk controller and IDE hard drive

controller. Plus an integrated SVGA with 512K Video RAM to speed up bus throughput — makes the system faster and more reliable! And there is still room for expansion with five open slots.

Three speeds! SlimLine 386 comes with your choice of 386DX 25 or 33MHz processors. For faster math-based applications — budgets, forecasts, spreadsheets and databases — all models feature 80387 coprocessor support to allow you to easily add floating point unit (FPU) performance.

33 Cache Systems!

All purpose systems! SlimLine Cache is the perfect network workstation or stand-alone unit for business and home use. It provides excellent support for advanced desktop publishing and graphics.

Base system includes 1Mb of RAM (expandable to 8Mb on the motherboard), a 40Mb fast access hard drive, 1.2Mb 5.25" and 1.44 3.5" floppy drives, a 12" VGA monochrome monitor and our exclusive *OmniKey*®/PLUS keyboard.

You name it, we'll build it! Performance options include hard drives up to our super-fast 15ms 200Mb Maxtor hard drive, monitors and video display cards, math coprocessors, tape backups, printers and a host of other choices.

Or select our Power System with 4Mb of RAM, a 200Mb fast access hard drive, 1.2Mb 5.25" and 1.44Mb 3.5" floppies, a 14" Super VGA color monitor and an *OmniKey* keyboard. Comes complete with Microsoft® Windows™ 3.0, Samna® Ami™ Professional word processing software, Informix® Wingz™ graphics spreadsheet and database software and a mouse to maximize system performance. This \$1139.00 suggested retail value software is yours at **NO EXTRA CHARGE!**

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a week, 24 hours a day. **PLUS**, free on-site next day service to most locations if we can't solve your problems over the phone.

Slimline 386 Base System Features:

- 25 or 33MHz Intel® 80386DX processor
- 1Mb of 32-bit DRAM (expandable to 8Mb on motherboard)
- Down-scaled, proprietary, U.S.-made motherboard
- 40Mb fast access hard drive; AT bus interface; 1:1 interleave; 32K or 64K look ahead disk caching
- 64K SRAM memory cache; read/write-back caching
- High density 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives; also read/write low density disks
- Five open expansion slots; three full length 16-bit and 2 half length 8-bit
- 25 or 33MHz 80387 or Weitek coprocessor support
- One parallel and two serial ports
- Built-in 16-bit SVGA with up to 1024 x 768 resolution; 512K video memory
- Clock/calendar chip rated at 5 years
- 100 watt power supply
- Small footprint SlimLine case with room for two exposed and 1 internal half-height devices
- Front mounted reset and high/low speed controls
- Exclusive Northgate *OmniKey* / PLUS keyboard
- 12" VGA monochrome monitor
- MS-DOS 4.01 and GW-BASIC software installed
- On-line User's Guide to the system and MS-DOS 4.01
- QA Plus diagnostic and utility software
- Smartdrive caching software
- 1 year warranty on system parts and labor; 5 years on keyboard
- FCC Class B Pending

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\$2999⁰⁰

Power User's System \$449⁰⁰

33MHz Base System Model

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Power User's System \$499⁰⁰

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Motherboard features include a built-in VGA adapter (with 512K Video RAM), parallel and two serial ports, fully integrated floppy disk

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Triple cache boosts performance to zero wait state! You get a built-in 64K memory SRAM cache to accelerate the execution of instructions; hard drive caching accelerates I/O transactions; and disk caching software speeds the movement of data to and from the CPU.

SlimLine™ 386SX 16 Or With 64K Cache!

SlimLine 386SX is perfect for office environments and home use. It handles word processing, spreadsheet, database management and most graphics applications with ease.

Slimline 386SX base system includes 1Mb of RAM (expandable to 8Mb) on the motherboard, a 40Mb fast access hard drive, 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives, and a 12" VGA monochrome monitor. Plus, you get Northgate's award-winning *OmniKey*®/102 keyboard.

Or, we'll build your system to your specs! There's room for three half-height devices including floppy drives, hard disk or tape backup. Choose from 80, 100, or our 200Mb hard drive with 15ms access. And, you still have five open expansion slots (3 full-length 16-bit, and 2 half-length 8-bit) for all of your peripherals.

Exceptional support! SlimLine 386SX is backed by expert technical support any time you need it. Call toll-free, 7 days a week, 24 hours

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SlimLine 386SX System Features:

- 16 or 20MHz Intel® 80386SX processor
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- 40Mb hard drive; AT bus interface; 1:1 interleave; DisCache; 64K look ahead disk caching; 19ms access
- 64K SRAM memory cache; read/write-back caching
- High density 1.2Mb 5.25" and 1.44Mb 3.5" floppy drives; also read/write low density disks
- Five open expansion slots; three full length 16-bit and two half length 8-bit
- 16 or 20MHz 80387SX or Weitek coprocessor support
- One parallel and two serial ports
- Built-in 16-bit SVGA with up to 1024 x 768 resolution; 512K video memory
- Clock/calendar chip rated at 5 years
- 100 watt power supply
- Small footprint SlimLine case with room for two exposed and one internal half-height devices
- Front mounted system reset and high/low speed controls
- Exclusive Northgate *OmniKey*/102 keyboard
- 12" VGA monochrome monitor
- MS-DOS 4.01 and GW-BASIC software installed
- On-line User's Guide to the system and MS-DOS 4.01
- QA Plus diagnostic and utility software
- Smartdrive disk caching software
- 1 year warranty on system parts and labor; 5 years on keyboard
- FCC Class B Certified

16 MHz
Base
System
Model

\$1999⁰⁰

20 MHz
Base
System
Model

\$2199⁰⁰

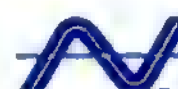
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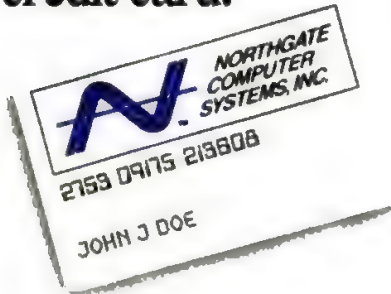
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Please complete all appropriate sections, providing at least two years residence and employment history. If you are self-employed, please be sure to complete section d. **THIS IS NOT A CREDIT AGREEMENT!** One will be sent to you upon authorization of an account. (This Form Must Be Signed To Process Your Order.) All Financed Purchases Are Subject To Credit Approval. If You Have Any Credit Questions, Please Call For Assistance. Thank You!

A married person may apply for individual credit. I am applying for (check one box, please):

- ☐ JOINT CREDIT with another person. Complete entire application.
☐ INDIVIDUAL CREDIT complete only individual section.
☐ INDIVIDUAL CREDIT but rely on income of another. Complete entire application.

*If you are a married Wisconsin applicant, you must provide your spouse's information as indicated, even though your spouse may not be signing the contract.

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WISCONSIN APPLICANTS**
You must disclose your marital
status:
☐ married
☐ unmarried
☐ legally separated

a. Personal Information

NAME _____ HOME PHONE () _____
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PRESENT ADDRESS _____ CITY _____ ST _____ ZIP _____
DATE OF RESIDENCE MO. _____ YR. _____ BUY ☐ RENT ☐ OTHER ☐
PREVIOUS ADDRESS _____
EMPLOYER _____ DATE OF EMPLOYMENT MO. _____ YR. _____
MONTHLY GROSS SALARY \$ _____ BUSINESS PHONE () _____
PREVIOUS EMPLOYER _____ DATES OF EMPLOYMENT _____ TO _____
Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as basis for repaying the obligation.
ADDITIONAL MONTHLY INCOME \$ _____ SOURCE _____

b. Credit Information

PLEASE TELL US IF YOU HAVE: CHECKING ACCOUNT (Y/N) _____ SAVINGS ACCOUNT (Y/N) _____
BANK LOAN (Y/N) _____ HOW MANY? _____ VISA (Y/N) _____ HOW MANY? _____
MASTERCARD (Y/N) _____ HOW MANY? _____ FINANCE COMPANY LOAN (Y/N) _____ HOW MANY? _____
DEPT. STORE CHARGE CARD (Y/N) _____ HOW MANY? _____ CREDIT UNION ACCOUNT (Y/N) _____ HOW MANY? _____
OTHER MAJOR CHARGE CARDS (Y/N) _____ HOW MANY? _____

c. Joint Applicant's Personal Information

JOINT APPLICANT'S NAME _____ HOME PHONE () _____
SOCIAL SECURITY NUMBER _____ DATE OF BIRTH ____/____/____
ADDRESS _____ CITY _____ ST _____ ZIP _____
DATE OF RESIDENCE MO. _____ YR. _____
JOINT APPLICANT'S EMPLOYER _____ DATE OF EMPLOYMENT MO. _____ YR. _____
MONTHLY GROSS SALARY \$ _____ BUSINESS PHONE () _____
NAME AND ADDRESS OF NEAREST RELATIVE NOT LIVING WITH YOU _____
RELATIONSHIP _____

d. Self-Employment Information

BUSINESS NAME _____ BUSINESS PHONE () _____
TYPE OF BUSINESS ☐ Proprietorship ☐ Partnership ☐ Corporation IN BUSINESS SINCE _____
YOUR ANNUAL INCOME FROM BUSINESS Gross \$ _____ Net \$ _____
PERSONAL BANKER'S NAME _____ BANKER'S PHONE () _____

e. Customer Authorization

I authorize Northgate Computer Systems or its assignees to investigate credit records and to report my performance hereunder to credit agencies. I hereby certify that the following information is furnished to you for the purpose of obtaining credit and is true and correct of the best of my knowledge and belief. There are costs associated with the use of this credit card. To obtain more information about these costs, call us at 1-800-548-1993 or write to P.O. Box 59080, Minneapolis, MN 55459-0080.

NY-A consumer credit report may be requested in connection with this application or in connection with updates, renewals or extensions of any credit granted as a result of this application. If I subsequently ask for this information, I will be informed whether or not such a report was requested and, if so, the name and address of the agency that furnished the report.

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APPLICANT'S SIGNATURE _____ DATE _____

JOINT APPLICANT'S SIGNATURE _____ DATE _____

FOR MARRIED WISCONSIN APPLICANTS:

I acknowledge that the obligation described herein is being incurred in the interest of my marriage or family.

BUYER'S SIGNATURE _____ DATE _____

*You must request deferred billing when ordering. Payments will be deferred for three billing cycles after shipment. Interest will accrue during the deferred period at a rate of 1.5% per month (18% APR). This is not an application. A completed application and agreement must be on file prior to approval for credit.

Utilities

WSMOOTH.DEF COMPLETE LISTING		
NAME	WinSmooth	
DESCRIPTION	'Smooth Scrolling Utility'	
EXETYPE	WINDOWS	
STUB	'WINSTUB.EXE'	
CODE	PRELOAD MOVEABLE	
DATA	PRELOAD MOVEABLE MULTIPLE	
HEAPSIZE	46080 ; 50k	
STACKSIZE	15360	
EXPORTS		
	MainWindowProc	01
About	#2	
OpenDlg	03	
Settings	#4	

Figure 3: This is the definition file for WSMOOTH.

WM_TIMER message as close to every second as it can. And to prevent a program from being bombarded with timer messages, *Windows* will combine adjacent WM_TIMER messages that it finds in the program's queue. So if your program receives 10 timer events before it has a

chance to act on them, *Windows* "merges" them all into one single timer event.

WSMOOTH uses the WM_TIMER messages to determine when to scroll the screen. But when the WM_TIMER message is received, WSMOOTH doesn't call a scrolling function. Instead, it posts a message *to itself* by calling PostMessage. This function places a message in a program's message queue; the program posting the message can be the same as the one receiving it. The message it posts, WM_VSCROLL, is the same one *Windows* employs to indicate that the user has clicked the vertical scroll bar.

A parameter to the message indicates what kind of action took place (for example, the messages SB_LINEUP or SB_LINEDOWN when the user presses the top or bottom arrow of the vertical scroll bar). Upon receiving a WM_VSCROLL message, WSMOOTH will call the ProcessVScroll function to handle the scrolling message.

There are a number of advantages to using a timer to control WSMOOTH's scrolling. First, WSMOOTH can use the interval between receiving WM_TIMER

and WM_VSCROLL to process other messages that may have been received. As mentioned above, when WSMOOTH receives a timer message, it posts a WM_VSCROLL message to itself indicating the direction to scroll. Now suppose that the user double-clicks the System icon of the Program Manager. *Windows* will post termination messages to each program. But what if the termination message is received between the WM_TIMER message and the WM_VSCROLL message? In this case, it's more efficient for WSMOOTH to execute the code to terminate itself: there's no point in going ahead and scrolling the window, since the user is shutting down *Windows* anyway.

This approach is much more efficient than letting messages accumulate in WSMOOTH's message queue. It is also more elegant than calling ProcessVScroll every time a WM_TIMER message is received. By generating a WM_VSCROLL message, WSMOOTH "fools" itself into thinking that the user has pressed the top or bottom of the vertical scroll bar. The logic of the program is therefore more consistent and uniform, and there's only one call to ProcessVScroll—whenever a WM_

We wanted to compare TOPS DOS BUNDLE to NetWare, but we didn't have enough time to install it.



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Utilities

VSCROLL message is received—regardless of where it came from. Whenever ProcessVScroll is called, it evaluates the scroll bar message and redetermines the relationship between the top row of text to be displayed and top pixel row on the window. Then WSMOOTH is ready to scroll the window.

BUILT-IN ROUTINE

Unlike the original SMOOTH, utility WSMOOTH does not manipulate the video adapter or CRT registers to create a smooth scrolling effect. Instead, it uses two built-in scrolling routines: ScrollWindow and ProcessVScroll.

A program calls ScrollWindow when the number of text lines being scrolled is less than the number displayed; or, in other words, when WSMOOTH is not scrolling everything out of the window. It specifies the number of pixel rows to be scrolled in either direction, and the area of the window to be scrolled. Windows then creates a bitmap of the scrolling area and redraws the bitmap at the calculated destination. Windows will also invalidate the area left uncovered by the scrolling. These invali-

dated areas are accumulated so that when the program repaints the window, it will know which portions of the window *must* be repainted.

If more than a windowful of text lines is being scrolled (for example, when you use PgUp/PgDn or when you drag the scroll bar slider), ProcessVScroll invalidates the entire window via InvalidateRect. In either case, it calls UpdateWindow, a Windows routine that sends a WM_PAINT message to WSMOOTH.

Notice the word *sends*. By sending a message to WSMOOTH rather than posting it, the WM_PAINT message is not placed in WSMOOTH's message queue. Instead, Windows calls MainWindowProc directly, forcing WSMOOTH to repaint its window immediately.

This technique is often used to get immediate action from a window procedure. However, because of the fact that it subverts the efficient, orderly processing of the messages already in the application's queue, it should be used only when absolutely necessary.

The message that is *sent* is executed *before* those that were previously posted to the application's message queue but not yet processed. Because UpdateWindow immediately causes WSMOOTH to get the WM_PAINT message, MainWindow-

WSMOOTH.H COMPLETE LISTING

```
// wsmooth.h RRS 9/1/95 - global defines

#define DEFAULTTMSecs 100
#define DEFAULTPIXELROWS 1
#define DEFAULTTRACK 0x00ffffff
#define DEFAULTFORE 0x00000000
#define DOWN 0
#define ESC 27
#define IDC_BU_SAVE 320
#define IDC_CANCEL_SETTINGS 318
#define IDC_CB_STRIP 308
#define IDC_CB_COLOR 310
#define IDC_CB_PIXELROWS 313
#define IDC_CB_SRATE 314
#define IDC_EDIT 201
#define IDC_FILENAME 200
#define IDC_FILES 202
#define IDC_LISTBOX 204
#define IDC_PATH 203
#define IDC_RB_PG 316
#define IDC_RB_BG 317
#define IDC_SB_GREEN 304
#define IDC_SB_RED 300
#define IDC_SB_BLUE 319
#define IDC_SB_PIXELROWS 311
#define IDC_SB_SRATE 312
#define IDM_SETTINGS 104
#define IDM_ABOUT 103
#define IDM_EXIT 102
#define IDM_OPEN 101
#define MAXLINE 100
#define MAXLINES 500
#define MAXMSECS 9999
#define MAXPIXELROWS 9
#define MINMSECS 5
#define MINPIXELROWS 0
#define MY_RBUTTON -1
#define SPACE 32
#define UP 1

#define WM_WSM_STARTTIMER 30415
#define WM_WSM_STOPTIMER 30425
#define WM_WSM_INCPixelROWS 30435
#define WM_WSM_DECPixelROWS 30445
#define WM_WSM_TERMREQUEST 30455
#define WM_WSM_HOURLASS_CURSOR 30465
#define WM_WSM_NORMAL_CURSOR 30475
```

Figure 4: This is the header file for WSMOOTH.

WSMOOTH.C

```
// wsmooth.c RRS 9/1/95

#include "windows.h"
#include "wsmooth.h"
#include "smooth2.h"
#include <stdio.h>
#include <string.h>
#include <malloc.h>
#include <stdarg.h>
#include <process.h>
#include <math.h>
#include "filebuf.h"

#define textrowsperpage() ((PixelRowsPerPage/CharLineHeight)+3)

#define SB_PIXELLINEUP (SB_LINEUP+0x0100)
#define SB_PIXELDOWN (SB_LINEDOWN+0x0100)

long nlines;
FILE *fp = NULL;
HWND WinSmooth = 0;
char filename[128];
char classname[50] = "WinSmooth";
char windowname[128] = "WinSmooth";
BOOL direction = DOWN;

HANDLE hOrgBrush;
HCURSOR hNormalCursor, hHourGlassCursor;
BOOL ab_init = FALSE;

SETTINGS settings =
{
    DEFAULTTMSecs,
    DEFAULTPIXELROWS,
    DEFAULTTRACK,
    DEFAULTFORE,
    FALSE
};

HANDLE hInstance;

void ResetPixelRows(void);
void ResetBackground( HDC hDC );
void RetrievesSettings(void);
void PaintMainWindow(HWND hwnd);

// beginning of WinSmooth
int PASCAL WinMain(HANDLE hInstance, HANDLE hPrevInstance,
LPSTR lpszCmdLine, int cmdShow)

{
    MSG msg;

    RetrievesSettings(); // retrieve settings from WIN.INI
    strcpy(lpszCmdLine, lpszCmdLine); // get (and override with)
    process_cmdline(filename); // command-line settings

    hOrgBrush = CreateSolidBrush(settings.back);

    if(!hPrevInstance)
    {
        WNDCLASS cl;

        cl.lpszClassName = (LPSTR) classname;
        cl.hInstance = hInstance;
        cl.lpfnWndProc = MainWindowProc;
        cl.hCursor = LoadCursor(NULL, IDC_ARROW);
        cl.hIcon = LoadIcon(hInstance, (LPSTR) "WSMOOTH");
        cl.lpszMenuName = (LPSTR) "FILEMENU";
        cl.hbrBackground = hOrgBrush;
        cl.style = CS_HREDRAW | CS_VREDRAW | CS_DBLCLKS;
        cl.cbClsExtra = 0;
        cl.cbWndExtra = 0;

        if(!RegisterClass(&cl))
            return FALSE;
        hNormalCursor = cl.hCursor;
    }

    hHourGlassCursor = LoadCursor(NULL, IDC_WAIT);
    WinSmooth = CreateWindow((LPSTR) classname,
        (LPSTR) windowname,
        WS_OVERLAPPEDWINDOW | WS_VSCROLL,
        CW_USEDEFAULT,
        CW_USEDEFAULT,
        CW_USEDEFAULT,
        CW_USEDEFAULT,
        NULL,
        NULL,
        hInstance,
        (LPSTR) NULL);
    if(!WinSmooth)
        return FALSE;

    ShowWindow(WinSmooth, cmdShow);
    UpdateWindow(WinSmooth);
    hInstance = hInstance;
    changeTitleBar(); // in case it wasn't done
}
```

Figure 5: This is the C source code listing for WSMOOTH.

```

//when file was opened
while(GetMessage(&msg, NULL, 0, 0))
{
    TranslateMessage(&msg);
    DispatchMessage(&msg);
}
exit(msg.wParam);
}

// Winsmooth termination and cleanup
BOOL FAR PASCAL CloseApplication(void)
{
    filebuf destruct();
    return TRUE;
}

struct _keytable
{
    WORD    virkey;
    int     msg;
    WORD    abcode;
} keyscroll[] =
{
    VK_PRIOR, WM_VSCROLL, SB_PAGEUP,
    VK_NEXT, WM_VSCROLL, SB_PAGEDOWN,
    VK_HOME, WM_VSCROLL, SB_TOP,
    VK_END, WM_VSCROLL, SB_BOTTOM,
    VK_UP, WM_VSCROLL, SB_LINEUP,
    VK_DOWN, WM_VSCROLL, SB_LINEDOWN
};

#define MAXKEYS (sizeof(keyscroll) / sizeof(keyscroll[0]))

#define MYTIMER 1
#define RBUTTONDOWNCLICK 2

// main window procedure for Winsmooth
long FAR PASCAL MainWndProc(HWND hwnd, unsigned message,
    WORD wParam, LONG lParam)
{
    static BOOL paused = TRUE, rbdclk = FALSE, app_activated = TRUE;
    static BOOL restart = TRUE;
    FARPROC lpProcAbout, lpOpenDialog, lpSettingsDialog;

    switch(message)
    {
        //////////////// Windows Messages
        case WM_CREATE:
        {
            if(!WSOpenFile(filename))
                PostMessage(hwnd, WM_COMMAND, IDM_OPEN, 0L);
            else
                PostMessage(hwnd, WM_WSM_STARTTIMER, 0, 0L);
        }
        break;

        case WM_PAINT:
            PaintMainWnd(hwnd);
            break;

        case WM_TIMER: // timer message
            switch(wParam)
            {
                case MYTIMER:
                    PostMessage(hwnd, WM_VSCROLL,
                        (direction == DOWN) ? SB_FIXLINEUP : SB_FIXLINEDOWN, 0L);
                    break;
                case RBUTTONDOWNCLICK:
                    KillTimer(hwnd, RBUTTONDOWNCLICK);
                    if(!rbdclk)
                        PostMessage(hwnd, WM_RBUTTONDOWN, MY_RBUTTON, 0L);
                    else
                        rbdclk = FALSE;
                    break;
            }
            break;

        case WM_VSCROLL: // vertical scrollbar message
            ProcessVscroll(hwnd, wParam, lParam);
            break;

        case WM_CLOSE: // close application
            DestroyWindow(hwnd);
            break;

        case WM_DESTROY: // destroy application
            CloseApplication();
            KillTimer(hwnd, MYTIMER);
            DeleteObject(horgBrush);
            PostQuitMessage(0);
            break;

        case WM_INITMENU: // stop timer when User uses menu
            if(paused)
                restart = FALSE;
            SendMessage(hwnd, WM_WSM_STOPTIMER, 0, 0L);
            break;

        case WM_ACTIVATE: // if activation message sent
            if(wParam == 0)
                app_activated = FALSE;
            break;

        case WM_COMMAND: // menu messages
            switch(wParam)
            {
                case IDM_OPEN: // open a new file
                    int newfile;
                    lpOpenDialog = MakeProcInstance(OpenDlg, hinstance);

```

```

// Open the file and get its handle
newfile = DialogBox(hinstance, "OPEN", hwnd, lpOpenDialog);
FreeProcInstance(lpOpenDialog);
if(newfile)
{
    sb_init = FALSE;
    SendMessage(hwnd, WM_VSCROLL, SB_TOP, 0L);
    InvalidateRect(hwnd, NULL, TRUE);
    SendMessage(hwnd, WM_PAINT, 0, 0L);
}
else
{
    int i;

    if((i = MessageBox(hwnd, "Terminate Winsmooth?", "Winsmooth",
        MB_OKCANCEL | MB_ICONQUESTION)) == IDOK)
        PostMessage(hwnd, WM_CLOSE, 0, 0L);
    else
        PostMessage(hwnd, WM_COMMAND, IDM_OPEN, 0L);
}
}
break;

case IDM_ABOUT: // display About box
    lpProcAbout = MakeProcInstance(About, hinstance);
    DialogBox(hinstance, "ABOUTBOX", hwnd, lpProcAbout);
    FreeProcInstance(lpProcAbout);
    break;

case IDM_SETTINGS:
    lpSettingsDialog = MakeProcInstance(Settings, hinstance);
    DialogBox(hinstance, "SETTINGS", hwnd, lpSettingsDialog);
    FreeProcInstance(lpSettingsDialog);
    break;

case IDM_EXIT: // terminate program
    PostMessage(hwnd, WM_CLOSE, 0, 0L);
    break;

default:
    break;
}

if(restart)
    SendMessage(hwnd, WM_WSM_STARTTIMER, 0, 0L);
}
break;

////////////////////// Mouse Message Handling
case WM_LBUTTONDOWN: // left mouse button == SPACE
    if(app_activated)
        PostMessage(hwnd, WM_CHAR, SPACE, 0L);
    app_activated = TRUE;
    break;

case WM_RBUTTONDOWN: // right mouse button == '-'
    if(wParam == MY_RBUTTON)
        PostMessage(hwnd, WM_CHAR, '-', 0L);
    else
    {
        rbdclk = FALSE;
        SetTimer(hwnd, RBUTTONDOWNCLICK, GetDoubleClickTime(), NULL);
    }
    break;

case WM_RBUTTONDOWNCLICK: // right button Double click == '+'
    rbdclk = TRUE;
    PostMessage(hwnd, WM_WSM_INCPXROWS, 0, 0L);
    break;

////////////////////// Keyboard Message handling
case WM_KEYDOWN:
{
    int i;

    PostMessage(hwnd, WM_WSM_STARTTIMER, 0, 0L);
    for(i = 0; i < MAXKEYS; i++)
        if(wParam == keyscroll[i].virkey)
        {
            SendMessage(hwnd, keyscroll[i].msg, keyscroll[i].abcode, 0L);
            break;
        }
}
break;

case WM_CHAR:
    PostMessage(hwnd, WM_WSM_STARTTIMER, 0, 0L);

    switch(wParam)
    {
        case ESC: // quit the application
            PostMessage(hwnd, WM_CLOSE, 0, 0L);
            break;

        case SPACE: // stop the timer
            if(!paused)
                PostMessage(hwnd, WM_WSM_STOPTIMER, 0, 0L);
            break;

        case '+': // increase # of rows scrolled
            PostMessage(hwnd, WM_WSM_INCPXROWS, 0, 0L);
            break;

        case '-': // decrease # of rows scrolled
            PostMessage(hwnd, WM_WSM_DECPXROWS, 0, 0L);
            break;

        default: // if 0-9, set # of rows scrolled
            if(wParam >= '0' && wParam <= '9')
            {
                settings.PixelRows = (wParam - '0');
                if(settings.PixelRows == MINPIXELROWS)
                    PostMessage(hwnd, WM_WSM_STOPTIMER, 0, 0L);
            }
    }
}

```



```

        break;
    }
    break;
    // Application Messages
case WM_WSM_STARTTIMER:
    if(!paused && settings.PixelRows > MINPIXELROWS)
        SetTimer(hwnd, MYTIMER, settings.Msecs, NULL);
    paused = FALSE;
    break;

case WM_WSM_STOPTIMER:
    if(!paused)
        KillTimer(hwnd, MYTIMER);
    paused = TRUE;
    break;

case WM_WSM_DECPixelROWS:
    if(settings.PixelRows > MINPIXELROWS)
    {
        settings.PixelRows--;
        if(settings.PixelRows == MINPIXELROWS)
            PostMessage(hwnd, WM_WSM_STOPTIMER, 0, 0);
    }
    break;

case WM_WSM_INCPixelROWS:
    if(settings.PixelRows < MAXPIXELROWS)
        settings.PixelRows++;
    break;

case WM_WSM_SCROLLCLASS_CURSOR:
    SetCursor(hScrollClassCursor);
    break;

case WM_WSM_NORMAL_CURSOR:
    SetCursor(hNormalCursor);
    break;

case WM_SIZE:
    ResetPixelRows(); // fall thru in case icon'd
default:
    return (DefWindowProc(hwnd, message, wParam, lParam));
    break;
}

return (0);
}

long NewPixTopRow = 0L, CurPixTopRow = 0L, BotPixRow = 0L;
unsigned PixelRowsPerPage = 0, CharLineHeight = 0, TextRowsPerPage;

// vertical scroll processing for WinSmooth
void ProcessVScroll(HWND hwnd, WORD wParam, LONG lParam)
{
    BOOL bscroll = FALSE;

    switch(wParam)
    {
        case SB_PIXELUP: // move up a pixel row
            NewPixTopRow = CurPixTopRow - settings.PixelRows;
            direction = UP;
            break;
        case SB_PIXELDOWN: // move down a pixel row
            NewPixTopRow = CurPixTopRow + settings.PixelRows;
            direction = DOWN;
            break;
        case SB_LINEUP: // move up a character row
            NewPixTopRow = CurPixTopRow - CharLineHeight;
            direction = UP;
            break;
        case SB_LINEDOWN: // move down a character row
            NewPixTopRow = CurPixTopRow + CharLineHeight;
            direction = DOWN;
            break;
        case SB_PAGEUP: // move up a 'page' of rows
            NewPixTopRow = CurPixTopRow - (PixelRowsPerPage - 1);
            break;
        case SB_PAGEDOWN: // move down a 'page' of rows
            NewPixTopRow = CurPixTopRow + PixelRowsPerPage - 1;
            break;
        case SB_TOP: // go to top row
            NewPixTopRow = 0L;
            break;
        case SB_BOTTOM: // go to bottom row
            if((NewPixTopRow = (BotPixRow - textrowsperpage())) < 0L)
                NewPixTopRow = 0L;
            break;
        case SB_THUMBPOSITION: // reset to new position
        case SB_THUMBTRACK: // reset to new position
            NewPixTopRow = (long)LOWORD(lParam);
            NewPixTopRow += CharLineHeight;
            break;
    }

    switch(wParam)
    {
        case SB_PIXELUP:
        case SB_LINEUP:
        case SB_PIXELDOWN:
        case SB_LINEDOWN:
        case SB_PAGEUP:
        case SB_PAGEDOWN:
        case SB_TOP:
        case SB_BOTTOM:
        case SB_THUMBPOSITION:
        case SB_THUMBTRACK:
            bscroll = TRUE;
            break;
    }

    NewPixTopRow = max(NewPixTopRow, 0L);
    NewPixTopRow = min(NewPixTopRow, BotPixRow);

```

```

    if(bscroll)
    {
        if((labs(NewPixTopRow - CurPixTopRow) < (long)PixelRowsPerPage))
        {
            int temp1;
            long temp2;

            temp2 = CurPixTopRow - NewPixTopRow;
            temp1 = (int)temp2;
            ScrollWindow(hwnd, 0, temp1, NULL, NULL);
        }
        else
            InvalidateRect(hwnd, NULL, TRUE);
        UpdateWindow(hwnd);
    }

    int Y, lineno;

    // WinSmooth paint procedure
    void PaintMainWindow(HWND hwnd)
    {
        PAINTSTRUCT ps;
        HDC hdc;

        int TextTopRow, recttop, rectbott;
        static int X, CharHeight;
        int botchar;

        BeginPaint(hwnd, &ps);
        recttop = ps.rcPaint.top;
        rectbott = ps.rcPaint.bottom;
        hdc = ps.hdc;

        if(!sb_init)
        {
            TEXTMETRIC taFontInfo;

            numlines = (long)filebuf numlines();
            GetTextMetrics(hdc, (LPTEXTMETRIC) &taFontInfo);
            CharLineHeight = taFontInfo.taExternalLeading + taFontInfo.taHeight;
            CharHeight = taFontInfo.taHeight;
            X = taFontInfo.taMaxCharWidth;

            BotPixRow = (numlines*CharLineHeight);
            SetScrollRange(hwnd, SB_VERT, 0, (unsigned)numlines, TRUE);

            ResetBackground(hdc);
            ResetPixelRows();
            sb_init = TRUE;
        }

        // for writing the text...
        SetBkMode(hdc, TRANSPARENT); // has to be for back ground dithering
        SetTextColor(hdc, settings.fore);
        SetBkColor(hdc, settings.back);

        Y = (int)(NewPixTopRow*CharLineHeight)-1;
        TextTopRow = max(0, (unsigned)(NewPixTopRow/CharLineHeight));

        for( lineno = TextTopRow; lineno < min((int)numlines, TextTopRow+
            TextRowsPerPage-1); lineno++)
        {
            botchar = Y+CharHeight;

            if( ((rectbott-recttop+1 < (int)CharLineHeight) &&
                ((recttop >= Y && recttop <= botchar) ||
                 (rectbott >= Y && rectbott <= botchar)))
            {
                (Y >= recttop && Y <= rectbott) ||
                (botchar >= recttop && botchar <= rectbott)
            {
                LPSTR p;
                unsigned len;

                filebuf seekline(lineno);
                p = filebuf nextline(&len);
                TextOut(hdc, X, Y, p, len);
            }
            Y += CharLineHeight;
        }

        CurPixTopRow = NewPixTopRow;
        SetScrollPos(hwnd, SB_VERT, (unsigned)(NewPixTopRow/CharLineHeight), TRUE);
        ValidateRect(hwnd, (LPRECT) NULL);
        EndPaint(hwnd, (LPPAINTSTRUCT) &ps);

        if((direction == DOWN) && (CurPixTopRow > (BotPixRow-textrowsperpage())))
            direction = UP;
        else if(CurPixTopRow == 0L && direction == UP)
            direction = DOWN;
    }

    // sets up background color for main window
    void ResetBackground(HDC hdc)
    {
        HANDLE holdBrush;

        hOrgBrush = CreateSolidBrush(settings.back);
        holdBrush = SelectObject(hdc, hOrgBrush);
        DeleteObject(holdBrush);
        SetClassWord(WinSmooth, GCW_HBRBACKGROUND, hOrgBrush);
    }

    // sets pixel row variable based on window size
    void ResetPixelRows(void)
    {
        RECT rect;

```

Utilities

WSMOOTH.C
4 of 4

```

if(WinSmooth)
{
    GetClientRect(WinSmooth, &rect);
    PixRowsPerPage = rect.bottom;
    if(CharLineHeight)
        TextRowsPerPage = textrowsperpage();
}

#define INIBUFSIZE 25
// retrieves WIN.INI settings for WinSmooth
void RetrieveSettings(void)
{
    char buf(INIBUFSIZE+1), defbuf(INIBUFSIZE+1);
    settings.Hsecs = GetProfileInt((LPSTR)"WinSmooth", (LPSTR)"Hsecs",
                                   settings.Hsecs);
    settings.PixelRows = GetProfileInt((LPSTR)"WinSmooth", (LPSTR)"PixelRows",
                                       settings.PixelRows);

    sprintf(defbuf, "%lu", settings.back);
    GetProfileString((LPSTR)"WinSmooth", (LPSTR)"BackGround",
                    (LPSTR)defbuf, (LPSTR)buf, INIBUFSIZE);
    sscanf(buf, "%lu", &settings.back);

    sprintf(defbuf, "%lu", settings.fore);
    GetProfileString((LPSTR)"WinSmooth", (LPSTR)"ForeGround",
                    (LPSTR)defbuf, (LPSTR)buf, INIBUFSIZE);
    sscanf(buf, "%lu", &settings.fore);

    settings.stripbits = GetProfileInt((LPSTR)"WinSmooth", (LPSTR)"StripBits",
                                       settings.stripbits);
}

// end of wsmooth.c
    
```

WSMOOTH.RC
1 of 2

```

#include "windows.h"
#include "wsmooth.h"

FILEMENU MENU
BEGIN
    POPUP      "&File"
    BEGIN
        MENUITEM    "&Open...", IDM_OPEN
        MENUITEM    "&Settings...", IDM_SETTINGS
        MENUITEM    SEPARATOR
        MENUITEM    "E&xit", IDM_EXIT
        MENUITEM    SEPARATOR
        MENUITEM    "&About WinSmooth...", IDM_ABOUT
    END
END

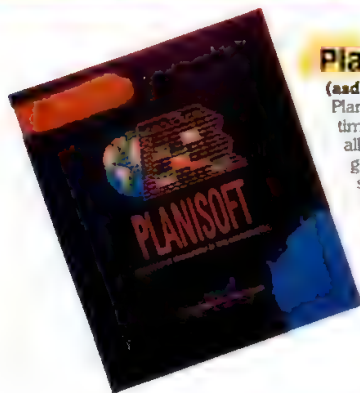
OPEN_DIALOG_LOADONCALL MOVEABLE DISCARDABLE 10, 10, 148, 112
CAPTION "Open File"
STYLE WS_BORDER | WS_CAPTION | WS_DLFRAME | WS_SYSMENU | DS_MODALFRAME
BEGIN
    CONTROL "Open File &Name:", IDC_FILENAME, "static", SS_LEFT | WS_GROUP | WS_CHILD, 4, 4, 60, 10
    CONTROL "", IDC_EDIT, "edit", ES_LEFT | ES_AUTOHSCROLL | WS_BORDER | WS_TABSTOP | WS_CHILD, 4, 16,
    100, 12
    CONTROL "&Files in", IDC_FILES, "static", SS_LEFT | WS_GROUP | WS_CHILD, 4, 40, 32, 10
    CONTROL "", IDC_LISTBOX, "listbox", LBS_SORT | LBS_NOTIFY | WS_BORDER | WS_VSCROLL | WS_TABSTOP |
    WS_CHILD, 4, 52, 70, 56
    CONTROL "", IDC_PATH, "static", SS_LEFT | WS_GROUP | WS_CHILD, 40, 40, 100, 10
    CONTROL "&Open", IDOK, "button", BS_DEFPUSHBUTTON | WS_TABSTOP | WS_CHILD, 87, 60, 50, 14
    CONTROL "Cancel", IDCANCEL, "button", BS_PUSHBUTTON | WS_TABSTOP | WS_CHILD, 87, 80, 50, 14
END

ABOUTBOX_DIALOG_LOADONCALL MOVEABLE DISCARDABLE 22, 17, 144, 80
CAPTION "About WinSmooth"
STYLE WS_BORDER | WS_CAPTION | WS_DLFRAME | WS_SYSMENU | DS_MODALFRAME
BEGIN
    CONTROL "WinSmooth, v.0.9", -1, "static", SS_CENTER | WS_GROUP | WS_CHILD, 9, 5, 144, 8
    ICON "WSMOOTH", -1, 61, 20, 0, 0
    CONTROL "by Richard Hale Shaw", -1, "static", SS_CENTER | WS_GROUP | WS_CHILD, 0, 44, 144, 8
    CONTROL "(c) 1990, Ziff-Davis Publishing Co.", -1, "static", SS_CENTER | WS_GROUP | WS_CHILD, 0, 54,
    144, 8
    CONTROL "OK", IDOK, "button", BS_DEFPUSHBUTTON | WS_GROUP | WS_TABSTOP | WS_CHILD, 53, 64, 32, 14
END

SETTINGS_DIALOG_LOADONCALL MOVEABLE DISCARDABLE 82, 14, 167, 163
CAPTION "WinSmooth Settings"
STYLE WS_BORDER | WS_CAPTION | WS_DLFRAME | WS_POPUP
BEGIN
    CONTROL "", IDC_SB_RED, "scrollbar", SBS_HORZ | WS_CHILD, 47, 57, 104, 9
    CONTROL "", IDC_SB_GREEN, "scrollbar", SBS_HORZ | WS_CHILD, 47, 68, 104, 9
    CONTROL "", IDC_SB_BLUE, "scrollbar", SBS_HORZ | WS_CHILD, 47, 79, 104, 9
    CONTROL "Strip Text High Bits (for WordStar Files)", IDC_CB_STRIP, "button", BS_AUTOCHECKBOX |
    WS_TABSTOP | WS_CHILD, 12, 130, 140, 10

    CONTROL "", 309, "static", SS_BLACKFRAME | WS_CHILD, 30, 100, 103, 10
    CONTROL "Scrolling text will look like this.", IDC_EB_COLOR, "static", SS_LEFT | WS_CHILD, 39, 109,
    101, 8
    
```

Figure 6: This is the resource script for WSMOOTH.



Planisoft

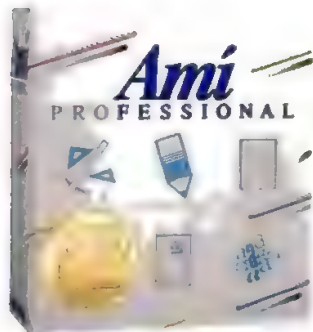
(and Software, Inc.)

Planisoft is a Windows 3.0 compatible time and resource management tool that allows you to coordinate individual and group agendas. Find available time-slots for appointments, keep track of deadlines and priorities, distribute tasks evenly and share information between PCs and Macs over any LAN. Planisoft is an indispensable tool for optimizing resources.
New.

CorelDRAW! 1.2

(Corel Systems)

CorelDRAW! 1.2 is fun and easy to use. Fit text to a curve, kern letters on screen, rotate, stretch, skew, copy, and combine. Over 100 typefaces and over 300 clipart images, free! Now a new program called CorelTRACE is bundled in at no extra cost. Converts bitmap images into vector graphics and handles large TIFF files without additional memory. **\$315.**



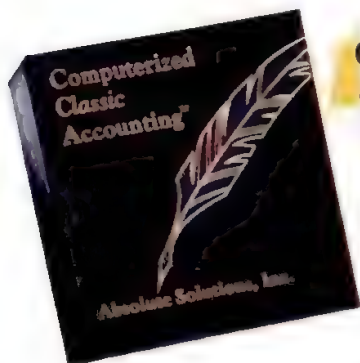
Ami Professional 1.2

(Samna)

Create your documents and page layouts at the same time. Ami Professional brings the graphical interface of Windows to word processing. Featuring advanced WYSIWYG display that not only shows you what your documents will look like, but will show you as you are writing them. **\$305.**

Cardinal 4800 SENDFAX Modem

(Cardinal) Achieve high speed FAX transmission from your PC to any Group III compatible FAX machine or PC FAX along with the capability to perform modem data communications at 2400, 1200, and 300 bps. Features include automatic FAXcast for multiple transactions and FLASHLINK Communications Software with MNP Class 5 operations for transmissions at twice the speed. **\$99.**



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(Absolute Solutions)

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SuperBase 4

(Precision Software)

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DataDesk International	
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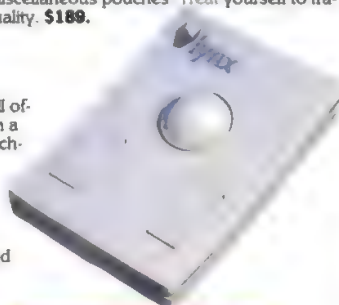
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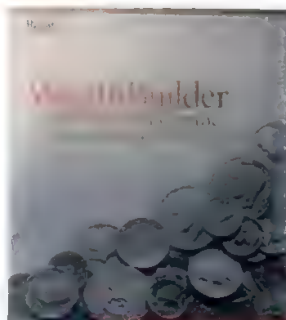
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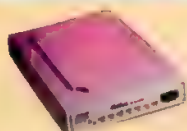
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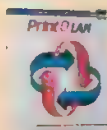
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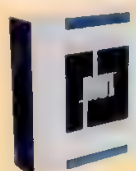
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CONTROL "", IDC_SB_PIXROWS, "scrollbar", SBS_VERT | WS_CHILD, 117, 25, 12, 19
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14
END

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// wsmooth2.h RHS 9/1/90 global structures and function prototypes

typedef struct _settings
{
    int Msecs;           // frequency of timer messages
    int PixelRows;       // number of pixel rows to scroll
    COLORREF back;        // background color
    COLORREF fore;        // foreground color
    BOOL stripbits;      // switch to control bit stripping
}; SETTINGS;

BOOL FAR PASCAL CloseApplication(void);
long FAR PASCAL MainWindowProc(HWND, unsigned, WORD, LONG);
void ProcessVscroll(HWND hwnd, WORD wParam, LONG lParam);
BOOL WsOpenFile(char *target);
void cdecl Message(HWND hwnd, char *format, ...);
void process_cmdline(char *buffer);
int PaintNow(HWND hwnd);
void ChangeTitleBar(void);
void free_lines(void);

BOOL FAR PASCAL Settings(HWND hDlg, unsigned message, WORD wParam,
    LONG lParam);
BOOL FAR PASCAL About(HWND hDlg, unsigned message, WORD wParam, LONG lParam);
BOOL CheckFileName(HWND hwnd, PSTR pDest, PSTR pSrc);
void AddExt(PSTR Name, PSTR Ext);
void SeparateFile(HWND hDlg, LPSTR lpDestPath, LPSTR lpDestFileName,
    LPSTR lpSrcFileName);
void ChangeDefExt(PSTR Ext, PSTR Name);
void UpdateListBox(HWND hDlg);
HANDLE FAR PASCAL OpenDlg(HWND hDlg, unsigned message, WORD wParam,
    LONG lParam);
void ResetBackGround(HDC hdc);

```

Figure 7: This file contains all the global structures and function prototypes for WSMOOTH.

Proc will call PaintMainWindow and immediately repaint that portion of the screen left uncovered after scrolling.

HOW OTHER FEATURES WORK

Adding messages and processing code to a window procedure is the gist of programming in *Windows*. For instance, when you press the Spacebar or click the left mouse

button over the WSMOOTH window, WSMOOTH will stop scrolling. Why? Whenever MainWindowProc receives a character input message, WM_CHAR, for space, or a mouse input message for the left button (WM_LBUTTONDOWN), it posts a WM_WSM_STOPTIMER message to itself. Upon receiving this message, WSMOOTH will stop the timer (if

it's running). The same logic is used to restart the timer. User-defined messages (such as WM_WSM_STOPTIMER) allow WSMOOTH to stop and start the timer, change the number of pixel rows scrolled, and treat keystrokes such as PgUp as if the user has clicked the vertical scroll bar above its slider.

One of the trickier messaging se-

WSMOOTH2.C

COMPLETE LISTING

```
// wsmooth2.c RRS adjunct routines for WinSmooth

#include<windows.h>
#include"wsmooth.h"
#include"wsmooth2.h"
#include<stdio.h>
#include<stdarg.h>
#include<string.h>
#include<stdlib.h>
#include<filebuf.h>

char mbuf[256];
// general message-to-user handler, like a printf for Windows
void cdecl Message(HWND hwnd, char *format, ...)
{
    va_list marker;

    va_start(marker, format);
    vsprintf(mbuf, format, marker);
    va_end(marker);

    MessageBox(hwnd, mbuf, "WinSmooth", MB_OK | MB_ICONEXCLAMATION);
}

extern SETTINGS settings;
extern HWND WinSmooth;
extern char windowname[128];
extern char filename[128];

// updates WinSmooth title bar
void ChangeTitleBar(void)
{
    char *p = strchr(windowname, ' ');

    if(!p)
        p = &windowname[strlen(windowname)];
    *p = '\0';

    strcpy(filename);
    strcat(windowname, " ");
    strcat(windowname, filename);
    SetWindowText(WinSmooth, (LPSTR)windowname);
}

// general function for initializing buffers and opening file
int WOpenFile(char *target)
{
    BOOL retval = TRUE;

    if(WinSmooth)
        SendMessage(WinSmooth, WM_WSM_HOURLASS_CURSOR, 0, 0L);
    if(!filebuf_init())
    {

```

```
        SendMessage(WinSmooth, WM_WSM_NORMAL_CURSOR, 0, 0L);
        Message(WinSmooth, "Fatal Error Initializing File Buffers!");
        retval = FALSE;
    }
    else if(!filebuf_open(target, settings.striplebits))
        retval = FALSE;

    if(WinSmooth)
    {
        ChangeTitleBar();
        SendMessage(WinSmooth, WM_WSM_NORMAL_CURSOR, 0, 0L);
    }
    return retval;
}

// reads filename and command-line options
void process_cmdline(char *buffer)
{
    char *p, *pMsecs;
    char *pPixelRows;
    char *pStripbits;

    pMsecs = pPixelRows = pStripbits = NULL;
    if(p = strchr(buffer, ' ')) // get msec parameter
    {
        *p++ = '\0';
        pMsecs = p;
        if(p = strchr(p, ' ')) // get pixel row parameter
        {
            *p++ = '\0';
            pPixelRows = p;
            if(p = strchr(p, ' ')) // get high bit switch
            {
                *p++ = '\0';
                pStripbits = p;
            }
        }
    }

    if(atol(pMsecs) > 0)
        settings.Msecs = atol(pMsecs);

    if(pPixelRows && (atol(pPixelRows) > 0))
        settings.PixelRows = atol(pPixelRows);

    if(pStripbits && (*pStripbits == '/' || *pStripbits == '-'))
        if(*(++pStripbits) != 'w' && *pStripbits != 'W') // if not "/w", "/W", "-w" or "-W"
            settings.striplebits = FALSE;
        else
            settings.striplebits = TRUE;
    }

    // end of wsmooth2.c

```

Figure 8: This file contains the support routines for WSMOOTH.

FILE.C

1 of 3

```
// file.c RRS functions for the File pulldown menu selections

#include<windows.h>
#include<stdio.h>
#include"wsmooth.h"
#include"wsmooth2.h"
#include<string.h>

#define WM_WSM_DLCPAINT (WM_USER+0x100)

extern HWND WinSmooth;

void InitSettings(HWND hDlg);
void ProcessHScroll(WORD wParam, LONG lParam);

void od_UpdateListBox(HWND hDlg);
void od_ChangeDirExt(PSTR Ext, PSTR Name);
void od_SeparateFilePath(HWND hDlg, LPSTR lpDestPath,
    LPSTR lpDestFilename, LPSTR lpSrcFilename);
void od_AddExtension(PSTR Name, PSTR Ext);

// About Box manager function
BOOL FAR PASCAL Settings(HWND hDlg, unsigned message, WORD wParam, LONG lParam)
{
    switch (message)
    {
        case WM_INITDIALOG:
            PostMessage(WinSmooth, WM_WSM_STOPTIMER, 0, 0L);
            return (TRUE);

        case WM_COMMAND:
            if (wParam == IDOK || wParam == IDCANCEL)
            {
                EndDialog(hDlg, TRUE);
                return (TRUE);
            }
    }

```

```
        break;
    }
    return (FALSE);
}

extern HANDLE hOrgBrush;
extern SETTINGS settings;

static SETTINGS s;
static HWND hRateScroll, hPixelRowsScroll, hRedScroll, hGreenScroll,
    hBlueScroll;
static HDC hDC;
static short fRed = 0, fGreen = 0, fBlue = 0, bRed = 0xff, bGreen = 0xff,
    bBlue = 0xff;
static unsigned foreground = 1;
static char text[50];

BOOL FAR PASCAL Settings(HWND hDlg, unsigned message, WORD wParam, LONG lParam)
{
    switch (message)
    {
        case WM_INITDIALOG:
            InitSettings(hDlg);
            return (TRUE);

        case WM_PAINT: // if dialog is painted
            PostMessage(hDlg, WM_WSM_DLCPAINT, 0, 0L);
            return FALSE;

        case WM_WSM_DLCPAINT:
            SetTextColor(hDC, RGB(fRed, fGreen, fBlue));
            SetBkColor(hDC, RGB(bRed, bGreen, bBlue));
            TextOut(hDC, 0, 0, (LPSTR)text, strlen(text));
    }

```

Figure 9: This file contains the module that handles all the processing entries in the file pull-down menu.


```

return TRUE;

case WM_VSCROLL: // handle changes to 2 scroll bars
{
    HWND hsb;
    char temp[10];
    if(hsb = HIWORD(lParam))
    {
        if(hsb == hRateScroll) // handle changes to rate scroll
        {
            if(wParam == SB_LINEDOWN && settings.Msecs > MINMSECS)
                settings.Msecs--;
            else if(wParam == SB_LINEUP && settings.Msecs < MAXMSECS)
                settings.Msecs++;
            sprintf(temp,"%4u",settings.Msecs);
            SetDlgItemText(hDlg, IDC_SB_RATE, temp);
        }
        if(hsb == hPixRowScroll) // handle changes to row scroll
        {
            if(wParam == SB_LINEDOWN && settings.PixelRows > MINPIXELROWS)
                settings.PixelRows--;
            else if(wParam == SB_LINEUP && settings.PixelRows < MAXPIXELROWS)
                settings.PixelRows++;
            sprintf(temp,"%4u",settings.PixelRows);
            SetDlgItemText(hDlg, IDC_SB_PIXELROWS, temp);
        }
    }
}
return TRUE;

case WM_HSCROLL:
ProcessHScroll(wParam, lParam);
return TRUE;

case WM_COMMAND:
switch(wParam)
{
    case IDC_SB_PG: // foreground/background switch
    case IDC_SB_BG:
        foreground = (wParam == IDC_SB_PG) ? TRUE : FALSE;
        SendMessage(GetDlgItem(hDlg, IDC_SB_PG), BM_SETCHECK,
            foreground, 0L);
        SendMessage(GetDlgItem(hDlg, IDC_SB_BG), BM_SETCHECK,
            !foreground, 0L);
        SetScrollPos(hRedScroll, SB_CTL, (foreground ? fRed : bRed),
            TRUE);
        SetScrollPos(hGreenScroll, SB_CTL,
            (foreground ? fGreen : bGreen), TRUE);
        SetScrollPos(hBlueScroll, SB_CTL,
            (foreground ? fBlue : bBlue), TRUE);
        break;

    case IDC_CB_STRIP:
        settings.stripbits = !settings.stripbits;
        break;

    case IDC_BU_SAVE: // save settings
    {
        char buf[20];

        SendMessage(WinSmooth, WM_WSM_HOURLASS_CURSOR, 0, 0L);
        settings.back = RGB(bRed, bGreen, bBlue);
        settings.fore = RGB(fRed, fGreen, fBlue);

        sprintf(buf, "%4d", settings.Msecs);
        WriteProfileString((LPSTR)"WinSmooth",
            (LPSTR)"Msecs", (LPSTR)buf);
        sprintf(buf, "%4d", settings.PixelRows);
        WriteProfileString((LPSTR)"WinSmooth",
            (LPSTR)"PixelRows", (LPSTR)buf);
        sprintf(buf, "%4u", settings.back);
        WriteProfileString((LPSTR)"WinSmooth",
            (LPSTR)"BackGround", (LPSTR)buf);
        sprintf(buf, "%4u", settings.fore);
        WriteProfileString((LPSTR)"WinSmooth",
            (LPSTR)"ForeGround", (LPSTR)buf);
        sprintf(buf, "%4d", settings.stripbits);
        WriteProfileString((LPSTR)"WinSmooth",
            (LPSTR)"stripbits", (LPSTR)buf);

        SendMessage(WinSmooth, WM_WSM_NORMAL_CURSOR, 0, 0L);
    }
    break;

    case IDCANCEL:
        settings = s; // structure assign to restore settings
    case IDOK: // save current settings
        if(wParam == IDOK) // save to WIN.INI
        {
            HDC h = GetDC(WinSmooth);

            settings.back = RGB(bRed, bGreen, bBlue);
            settings.fore = RGB(fRed, fGreen, fBlue);
            ResetBackGround(h);
            ChangeTitleBar();
            settings.stripbits = (SendMessage(
                GetDlgItem(hDlg, IDC_CB_STRIP),
                BM_SETCHECK, 0, 0L) ? TRUE : FALSE);
            ReleaseDC(WinSmooth, h);
            InvalidateRect(WinSmooth, NULL, TRUE);
        }
        // code common to OK and CANCEL
        ReleaseDC(hDlg, hDC);
        EndDialog(hDlg, TRUE);
        return (TRUE);
    default:
        break;
}
}

```

```

break;
return (FALSE);
}

// initialize settings dialog
void InitSettings(HWND hDlg)
{
    HWND hwnd;
    char temp[10];

    s = settings; // structure assign to save settings
    // initialize the edit boxes
    sprintf(temp, "%4u", settings.Msecs);
    SetDlgItemText(hDlg, IDC_SB_RATE, temp);
    sprintf(temp, "%4u", settings.PixelRows);
    SetDlgItemText(hDlg, IDC_SB_PIXELROWS, temp);

    // get the horizontal scroll handles
    hRateScroll = GetDlgItem(hDlg, IDC_SB_RATE);
    hPixRowScroll = GetDlgItem(hDlg, IDC_SB_PIXELROWS);
    hRedScroll = GetDlgItem(hDlg, IDC_SB_RED);
    hGreenScroll = GetDlgItem(hDlg, IDC_SB_GREEN);
    hBlueScroll = GetDlgItem(hDlg, IDC_SB_BLUE);

    // set the scroll bar ranges
    SetScrollRange(hRateScroll, SB_CTL, MINMSECS, MAXMSECS, TRUE);
    SetScrollRange(hPixRowScroll, SB_CTL, MINPIXELROWS, MAXPIXELROWS, TRUE);
    SetScrollRange(hRedScroll, SB_CTL, 0, 255, TRUE);
    SetScrollRange(hGreenScroll, SB_CTL, 0, 255, TRUE);
    SetScrollRange(hBlueScroll, SB_CTL, 0, 255, TRUE);

    // and color scroll bar positions
    fRed = GetRValue(settings.fore);
    fGreen = GetGValue(settings.fore);
    fBlue = GetBValue(settings.fore);
    bRed = GetRValue(settings.back);
    bGreen = GetGValue(settings.back);
    bBlue = GetBValue(settings.back);

    SetScrollPos(hRedScroll, SB_CTL, (foreground ? fRed : bRed), TRUE);
    SetScrollPos(hGreenScroll, SB_CTL, (foreground ? fGreen : bGreen), TRUE);
    SetScrollPos(hBlueScroll, SB_CTL, (foreground ? fBlue : bBlue), TRUE);

    // and color of sample text
    hDC = GetDC(hwnd = GetDlgItem(hDlg, IDC_SB_COLOR));
    GetDlgItemText(hDlg, IDC_SB_COLOR, (LPSTR)text, sizeof(text)-1);
    SetClassWord(hwnd, GCW_HBRACKGROUND, hOrgBrush);

    SetBkMode(hDC, OPAQUE); // has to be OPAQUE for background
    // color to show
    // check/uncheck the check box
    SendMessage(GetDlgItem(hDlg, IDC_CB_STRIP), BM_SETCHECK,
        settings.stripbits, 0L);
    // check the foreground radio button
    SendMessage(GetDlgItem(hDlg, IDC_SB_PG), BM_SETCHECK, foreground, 0L);
    // uncheck the background
    SendMessage(GetDlgItem(hDlg, IDC_SB_BG), BM_SETCHECK, !foreground, 0L);
}

// processes color-setting horizontal scroll bars
void ProcessHScroll(WPARAM wParam, LPARAM lParam)
{
    HWND hsb;
    short *color;

    hsb = HIWORD(lParam);
    if(hsb == hRedScroll)
        color = (foreground ? &fRed : &bRed);
    if(hsb == hGreenScroll)
        color = (foreground ? &fGreen : &bGreen);
    if(hsb == hBlueScroll)
        color = (foreground ? &fBlue : &bBlue);

    switch(wParam)
    {
        case SB_PAGEDOWN:
            *color += 15; // fall thru
        case SB_LINEDOWN:
            *color = min(255, *color+1);
            break;
        case SB_PAGEUP:
            *color -= 15; // fall thru
        case SB_LINEUP:
            *color = max(0, *color-1);
            break;
        case SB_TOP:
            *color = 0;
            break;
        case SB_BOTTOM:
            *color = 255;
            break;
        case SB_THUMBPOSITION:
        case SB_THUMBTRACK:
            *color = LOWORD(lParam);
            break;
        default:
            break;
    }

    SetScrollPos(hsb, SB_CTL, *color, TRUE);
    SetTextColor(hDC, RGB(fRed, fGreen, fBlue));
    SetBkColor(hDC, RGB(bRed, bGreen, bBlue));

    TextOut(hDC, 0, 0, (LPSTR)text, strlen(text));
}

char od_filename[128];
char od_openname[128];
char od_defpath[128];
char od_defspec[13] = ".txt";
char od_default_extension[] = ".txt";
char str[255];

// lets user select and open files
HANDLE FAR PASCAL OpenDlg(HWND hDlg, unsigned message, WORD wParam,
    LONG lParam)

```

```

BOOL result;
switch (message)
{
    case WM_INITDIALOG:
        // message: initialize
        od_UpdateListBox(hDlg);
        SetDlgItemText(hDlg, IDC_EDIT, od_defspec);
        SendDlgItemMessage(hDlg, IDC_EDIT, EM_SETSEL, NULL,
            MAKELONG(0, 0x7fff));
        SetFocus(GetDlgItem(hDlg, IDC_EDIT));
        return (FALSE); // indicates the focus is set to a control
        break;

    case WM_COMMAND:
        switch (wParam)
        {
            case IDC_LISTBOX:
                switch (HIWORD(lParam))
                {
                    case LBN_SELCHANGE:
                        // If item is a directory name, append "...
                        if (DigDirSelect(hDlg, str, IDC_LISTBOX))
                            strcat(str, od_defspec);

                        SetDlgItemText(hDlg, IDC_EDIT, str);
                        SendDlgItemMessage(hDlg,
                            IDC_EDIT,
                            EM_SETSEL,
                            NULL,
                            MAKELONG(0, 0x7fff));
                        break;

                    case LBN_DBLCLK:
                        goto openfile;
                }
                return (TRUE);
                break;

            case IDOK:
                GetDlgItemText(hDlg, IDC_EDIT, od_openname, 128);
                if (strchr(od_openname, '.') || strchr(od_openname, '?'))
                {
                    od_SeparateFilePath(hDlg, (LPSTR) str, (LPSTR) od_defspec,
                        (LPSTR) od_openname);
                    if (str[0])
                        strcpy(od_defpath, str);
                    od_ChangedExt(od_defspec, od_defspec);
                    od_UpdateListBox(hDlg);
                    return (TRUE);
                }

                if (!od_openname[0])
                {
                    MessageBox(hDlg, "No filename specified.",
                        NULL, MB_OK | MB_ICONHAND);
                    return (TRUE);
                }

                od_AddExtension(od_openname, od_defspec);
                // open the file
                result = WOpenFile(od_openname);
                strcpy(od_filename, od_openname);
                EndDialog(hDlg, result);
                return (TRUE);

            case IDCANCEL:
                EndDialog(hDlg, FALSE);
                break;
        }
        return (FALSE);
    }

    // updates the list box in the Open Dialog
    void od_UpdateListBox(HWND hDlg)
    {
        strcpy(str, od_defpath);
        strcat(str, od_defspec);
        DigDirList(hDlg, str, IDC_LISTBOX, IDC_PATH, 0x4010);

        // list is for subdir of current drive directory
        if (strchr(od_defpath, '.'))
            DigDirList(hDlg, od_defspec, IDC_LISTBOX, IDC_PATH, 0x4010);

        // remove the "...", if one
        if (strchr(od_defpath, "..."))
            od_defpath[0] = '\0';
        SetDlgItemText(hDlg, IDC_EDIT, od_defspec);
    }

    // changes default extension
    void od_ChangedExt(PSTR Ext, PSTR Name)
    {
        PSTR pptr;

        pptr = Name;
        while (*pptr && *pptr != '.')
            pptr++;
        if (*pptr)
            if (strchr(pptr, '.') && strchr(pptr, '?'))
                strcpy(Ext, pptr);
    }

    // separates file and path names
    void od_SeparateFilePath(HWND hDlg, LPSTR lpDestPath,
        LPSTR lpDestFileName, LPSTR lpSrcFileName)
    {
        LPSTR lpTmp;
        char ctmp;

        lpTmp = lpSrcFileName + (long) strlen(lpSrcFileName);
        while (*lpTmp != '.' && *lpTmp != '\\' && lpTmp > lpSrcFileName)
            lpTmp = AnsiPrev(lpSrcFileName, lpTmp);
        if (*lpTmp != '.' && *lpTmp != '\\')
            strcpy(lpDestFileName, lpSrcFileName);
            lpDestPath[0] = '\0';
            return;

        strcpy(lpDestFileName, lpTmp + 1);
        ctmp = *(lpTmp + 1);
        strcpy(lpDestPath, lpSrcFileName);
        *(lpTmp + 1) = ctmp;
        lpDestPath[(lpTmp - lpSrcFileName) + 1] = '\0';
    }

    // adds default extension
    void od_AddExtension(PSTR Name, PSTR Ext)
    {
        PSTR pptr;

        pptr = Name;
        while (*pptr && *pptr != '.')
            pptr++;
        if (*pptr != '.')
            strcat(Name, Ext);
    }
}

```

```

// filebuf.h RES 9/1/90
int filebuf_init(void);
int filebuf_open(char *filename, int strip);
void filebuf_destruct(void);
void filebuf_seekline(unsigned line);
char far *filebuf_nextline(unsigned *len);
unsigned filebuf_nlines(void);
unsigned filebuf_longestline(void);

```

Figure 10: This is the header file for any module that uses the routines contained in FILEBUF.C.

quences involves the facility for increasing the number of pixel rows WSMOOTH scrolls. As mentioned, you can decrease this number with a single click of the right mouse button (which generates a WM_RBUTTONDOWN). You can increase it by double-clicking that button,

but Windows will send a WM_RBUTTONDOWN, followed by a WM_RBUTTONDOWNBLCLK. In other words, when a WM_RBUTTONDOWN is received, there's no way for WSMOOTH to know whether the message represents a single click or the beginning of a double-click.

To solve this problem, WSMOOTH creates a new timer when the first WM_RBUTTONDOWN is received. This timer is set to the value of the DoubleClickTime setting in your WIN.INI file. When WSMOOTH receives a WM_TIMER message for this timer, it checks to see whether or not a WM_RBUTTONDOWNBLCLK has been received since the timer was started. If one has been received, it ignores the timer message. But if one has not been received, WSMOOTH generates a WM_RBUTTONDOWN message with a

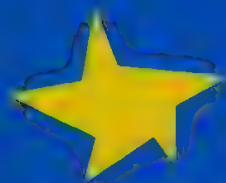
parameter indicating that this is in fact a true single-click of the right button.

THE SPLIT FILE BUFFER

WSMOOTH inherits a great deal of the file-handling technology used in the original SMOOTH—which in turn was inherited from Michael J. Mefford's own DR and Charles Petzold's BROWSE.

The major difference between SMOOTH and WSMOOTH's file-handling is that SMOOTH doesn't have scroll bars. While you can jump from one end of the file to the other, or use PgUp/PgDn to move from page to page, there's no way you can use SMOOTH to jump to any part of the file. Windows' scroll bars make this facility imperative—otherwise, what would be the point of scroll bars?

To implement this particular feature,

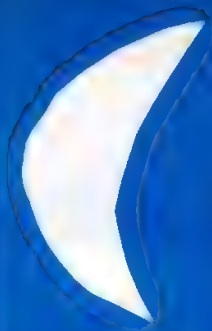


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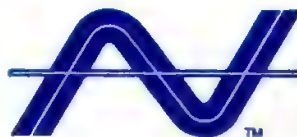
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```

// filebuf.c RES 9/1/98 file-buffering and handling routines

#ifdef WINDOWS
#include<windows.h>
#include<wsmooth.h>
#include<wsmooth2.h>
#endif

#include<stdio.h>
#include<stdlib.h>
#include<string.h>
#include<malloc.h>
#include<dos.h>
#include<fcntl.h>
#include<sys\types.h>
#include<sys\stat.h>
#include<io.h>
#include<filebuf.h>

#define TRUE 1
#define FALSE 0
#define MAXSCREEN 25
#define CTRL_Z 0x1A
#define CR '\r'
#define LF '\n'
#define MYEOF 0xffff

#define PAGEINDEXSIZE 58
#define HALFBUFFER (38*1024)
#define MAXFILESIZE ((1000*PAGEINDEXSIZE*(long)HALFBUFFER)
#define BUFFERSIZE (HALFBUFFER*2)

#ifdef defined(WINDOWS)
HANDLE indexbufhdl = NULL, bufferhdl = NULL;
extern HWND WinSmooth;
#endif

unsigned far *lineptr; // pointer to line index in index segment
unsigned far *pageptr; // pointer to page index in index segment
unsigned far *indexstart = NULL; // pointer to start of line index
unsigned far *indexbuf = NULL; // pointer to index buffer
char far *fileptr = NULL; // pointer to curr line
char far *bufstart = NULL; // pointer to start of filebuffer
char far *bufend; // point to end of buffer
int fh = -1;
int stripbits = FALSE;

void filebuf_updateindex(int endndx);
void filebuf_read(void);
void filebuf_nextbuffer(void);
void filebuf_prevbuffer(void);
void filebuf_reset(void);
void filebuf_stripbits(char far *buf, unsigned len);
void error_exit(int err, char *msg);

// strips high bit from bytes read
void filebuf_stripbits(char far *buf, unsigned len)
{
    if(!stripbits)
        return;
    for( ; len; len--)
        buf[len-1] &= 0x7f;
}

// initializes file buffers
int filebuf_init(void)
{
    if(indexbufhdl && bufferhdl)
    {
        filebuf_reset();
        return TRUE;
    }

    // allocate index buffer and file buffer
#ifdef WINDOWS
    {
        unsigned u = BUFFERSIZE+1; // use an unsigned to get
        // over compiler bug
        // allocate index and file buffers
        if(indexbufhdl = GlobalAlloc(GMEM_MOVEABLE,u))
            indexbuf = (unsigned far *)GlobalWire(indexbufhdl);

        if(bufferhdl = GlobalAlloc(GMEM_MOVEABLE,u))
            bufstart = (char far *)GlobalWire(bufferhdl);

        if(!indexbufhdl || !bufferhdl)
        {
            Message(WinSmooth,"Unable to allocate memory buffers: hdl=<u>,<u>
            ptr=<tlp>,<tlp> size=<uld>,<indexbufhdl>,<bufferhdl>,<indexbuf>,<
            bufstart>,<GlobalSize>(<indexbufhdl>);
            return FALSE;
        }
    }

    if(!indexbuf || !bufstart)
        Message(WinSmooth,"Unable to re-locate memory buffers: ptr=<tlp>,<tlp>,<
        indexbuf>,<bufstart>);
#else
    indexbuf = (unsigned far *) malloc(BUFFERSIZE+1);
    bufstart = (char far *) malloc(BUFFERSIZE+1);
    if(!indexbuf || !bufstart)
        error_exit(8,"No buffer allocation");
#endif

    // set line pointer to beginning of line index
    indexstart = lineptr = indexbuf+(PAGEINDEXSIZE);
    // set page pointer to beginning of page index
    pageptr = indexbuf;
    // initialize indexes
    _fmemset(indexbuf,0x0000,BUFFERSIZE);
    // set last word of line index to MYEOF
    indexbuf[BUFFERSIZE/(sizeof(unsigned))] = MYEOF;

    return TRUE;
}

// resets variables for new file without re-allocating buffers
void filebuf_reset(void)
{
    lineptr = indexstart;
    pageptr = indexbuf;
    fileptr = NULL;
    _fmemset(indexbuf,0x0000,BUFFERSIZE);
}

int filebuf_open(char *filename, int strip)
{
    if(!(*filename))
        return FALSE;

#ifdef WINDOWS
    {
        OFSTRUCT of;
        // open the file for read only, and allow others to
        // read it (but not write)
        if((fh = OpenFile(filename,<of>
            OF_CANCEL | OF_PROMPT | OF_READ | OF_SHARE_DENY_WRITE)) == -1)
        {
            Message(WinSmooth,"Error td opening <ts>,<of>,<nErrCode>,<filename>;
            return FALSE;
        }
    }
#else
    if((fh = open(filename,O_BINARY | O_RDONLY)) == -1)
        error_exit(8,"Unable to open file");
#endif

    struct stat s;
    if(fstat(fh,<s>)) // get file size
        return FALSE;
    if(s.st_size > MAXFILESIZE) // check file size
    {
#ifdef WINDOWS
        Message(WinSmooth,"<ts> is too large to be handled by WinSmooth",
            filename);
        return FALSE;
    }
    else
        error_exit(8,"File too large");
    }

    filebuf_read(); // get first buffer from file

    {
        unsigned len; // read entire file
        for(len = 1; filebuf_nextline(<slen>) && len; );
    }

    stripbits = (strip ? TRUE : FALSE);
    return TRUE;
}

// de-allocates filebuffers and cleans up
void filebuf_destruct(void)
{
    if defined(WINDOWS)
    {
        if(indexbufhdl)
        {
            GlobalUnWire(indexbufhdl);
            GlobalFree(indexbufhdl);
        }
        if(bufferhdl)
        {
            GlobalUnWire(bufferhdl);
            GlobalFree(bufferhdl);
        }
        indexbufhdl = bufferhdl = NULL;
    }
    else
    {
        if(indexbuf)
            free(indexbuf);
        if(bufstart)
            free(bufstart);
        bufstart = NULL;
        indexbuf = NULL;
    }
    if(fh != -1)
        close(fh);
    fh = -1;
}

// reads buffer from file
void filebuf_read(void)
{
    unsigned bytes;
    lseek(fh,(HALFBUFFER*(pageptr-indexbuf),SEEK_SET);
    dos_read(fh,<bufstart>[HALFBUFFER],HALFBUFFER,<bytes>);
    FileBuf_stripbits(<bufstart>[HALFBUFFER],HALFBUFFER);

    fileptr = (ifileptr ? <bufstart>[HALFBUFFER] : (fileptr == HALFBUFFER));

    bufend = <bufstart>[HALFBUFFER+bytes]; // set to end of buffer
    *bufend = CTRL_Z;
    filebuf_updateindex((bytes != HALFBUFFER) ? TRUE : FALSE);
}

```

Figure 11: This is the code for file and buffer handling routines.

```

// updates line index for buffer
void filebuf_updateindex(int endndx)
{
    char far *buf = fileptr;
    char far *old = fileptr;
    unsigned far *ndx = lineptr;
    unsigned numlines = ((pageptr == indexbuf) ? 0 : pageptr[-1]);

    while(buf <= bufend) // until end of buffer
        switch(*buf)
        {
            case CR: // if CR or LF found
            case LF:
                buf++; // check next character
                // if CR followed by line feed
                if(*buf == LF)
                    buf++;
                *ndx++ = (buf - old); // use ptr arithmetic to get length
                numlines++;
                old = buf; // set old to next line
                if(buf == bufend)
                    buf++; // break so as not to fall thru
            case CTRL_Z: // CTRL_Z found, set new buf end
                if(buf > old) // if line ends with CTRL_Z
                    *ndx++ = 0;
                buf++;
                break;
            default:
                buf++;
                break;
        }
    *pageptr = numlines; // set to accumulated line count
    if(endndx) // if end of file reached
        *ndx = EOF; // set end of file marker in index
}

// read next buffer from file
void filebuf_nextbuffer(void)
{
    // copy the 2nd half of buffer to the 1st half
    memcpy(bufstart, &bufstart[HALFBUFFER], HALFBUFFER);
    pageptr++; // set for next page

    // read HALFBUFFER bytes into 2nd half
    filebuf_read();
}

// read previous buffer from file
void filebuf_prevbuffer(void)
{
    if(pageptr == indexbuf) // insure we're not on 1st page
        return;

    memcpy(&bufstart[HALFBUFFER], bufstart, HALFBUFFER);
    fileptr += HALFBUFFER; // adjust pointer to its
                          // position in 2nd page
    pageptr--; // seek to page
    lseek(fh, (HALFBUFFER*(pageptr-indexbuf)), SEEK_SET);
    {
        unsigned bytes;
        _dos_read(fh, bufstart, HALFBUFFER, &bytes); // read the file into
        // the 1st buffer
        filebuf_stripbits(bufstart, HALFBUFFER);
        bufend = &bufstart[HALFBUFFER]; // set to end of buffer
        *bufend = CTRL_Z;
    }
}

// seek to a particular line
void filebuf_seekline(unsigned line)
{
    unsigned far *page = indexbuf, far *buf1, far *buf2, far *ndx;

    // find a page with a higher accum. line count
    for( ; line > *page && *page; page++);

    if(page == indexbuf) // if we're on the first page
        // (no prev. page)
    {
        buf1 = page; // set for first 2 buffers
        buf2 = page+1;
    }
    else if(*page+1 == 0) // or not on 1st page and next
        // page is empty
    {
        buf1 = page-1; // set for this and prev buffer
        buf2 = page;
    }
    else // or we are between two real pages
    {
        if(line > (*page-1) + ((*page+1) - *page) / 2)
        {
            buf1 = page;
            buf2 = page+1;
        }
        else
        {
            buf1 = page-1;
            buf2 = page;
        }
    }

    lineptr = indexstart+line; // set lineptr to the line
    pageptr = page; // set pageptr to the page

    if(*buf2) // if no 2nd page, nothing to read
    {
        unsigned bytes; // read 1st buffer
        lseek(fh, (HALFBUFFER*(buf1-indexbuf)), SEEK_SET);
        _dos_read(fh, bufstart, HALFBUFFER, &bytes);
        lseek(fh, (HALFBUFFER*(buf2-indexbuf)), SEEK_SET);
        _dos_read(fh, &bufstart[HALFBUFFER], HALFBUFFER, &bytes);
        filebuf_stripbits(bufstart, HALFBUFFER*2);
    }
}

```

```

bufend = &bufstart[HALFBUFFER+bytes]; // set to end of buffer
*bufend = CTRL_Z;
fileptr = (page == buf1) ? bufstart : &bufstart[HALFBUFFER];
}
else
    fileptr = &bufstart[HALFBUFFER];
ndx = indexstart;
ndx += ((pageptr == indexbuf) ? 0 : *(pageptr-1));

if(*buf2)
    if(fileptr != bufstart)
        while(fileptr[-1] != CR && fileptr[-1] != LF)
            fileptr--;
    else if(lineptr == indexstart)
    {
        ndx++;
        while(fileptr[1] != CR && fileptr[1] != LF)
            fileptr++;
        fileptr++;
        while(*fileptr == CR || *fileptr == LF)
            fileptr++;
    }
    for( ; ndx < lineptr; fileptr += *ndx, ndx++)
        ;

// get next line from file
char far *filebuf_nextline(unsigned *len)
{
    char far *linestart;
    char far *bufptr; // local pointer

    *len = 0;

    if(*lineptr == EOF)
        return NULL;

    reset:
    linestart = fileptr; // set linestart to fileptr
    // read until buffer end encountered, or until CR found
    for( bufptr = fileptr; bufptr != bufend; bufptr++)
        if(*bufptr == CR || *bufptr == LF)
            break;
    if(bufptr == bufend) // end of buffer, line carries over
    {
        filebuf_nextbuffer(); // read more of file
        goto reset;
    }
    *len = (bufptr - fileptr); // remove CR from buf
    fileptr = *lineptr++;
    return linestart;
}

// get previous line from file
char far *filebuf_prevline(unsigned *len)
{
    char far *bufptr;

    *len = 0;

    if(lineptr == indexstart) // if at beginning of file
        return NULL;

    --lineptr; // set to previous line
    bufptr = bufstart+HALFBUFFER;
    if((fileptr > bufptr) && ((fileptr - *lineptr) <= bufptr))
        pageptr--; // set to prev page
    if((bufstart + *lineptr) > fileptr) // if line length extends from
        // previous page
    {
        filebuf_prevbuffer();
        fileptr = (*lineptr);
    }
    for(bufptr = fileptr; bufptr != bufend; bufptr++)
        if(*bufptr == CR || *bufptr == LF)
            break;
    *len = (bufptr - fileptr);
    return fileptr;
}

// returns number of lines line file
unsigned filebuf_nmlines(void)
{
    unsigned far *page;
    for(page = indexbuf; *page+1; page++)
        ;
    return *page;
}

// returns length of longest line in file
unsigned filebuf_longestline(void)
{
    unsigned far *ndx = indexstart;
    unsigned longest = 0;

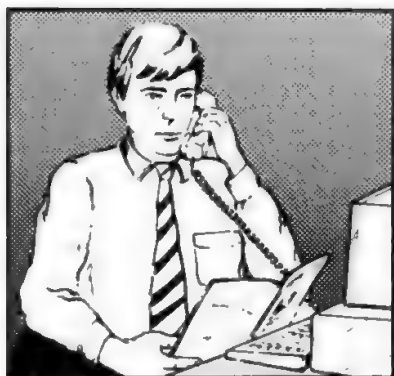
    for(if(*ndx >= longest; ndx++)
        longest = *ndx;
    return longest;
}

// exit routine on fatal error
void error_exit(int err, char *msg)
{
    #if defined(WINDOWS)
        extern HWND WinSmooth;
        Message(WinSmooth, msg);
    #else
        printf("%s\n", msg);
    #endif
    exit(err);
}

```


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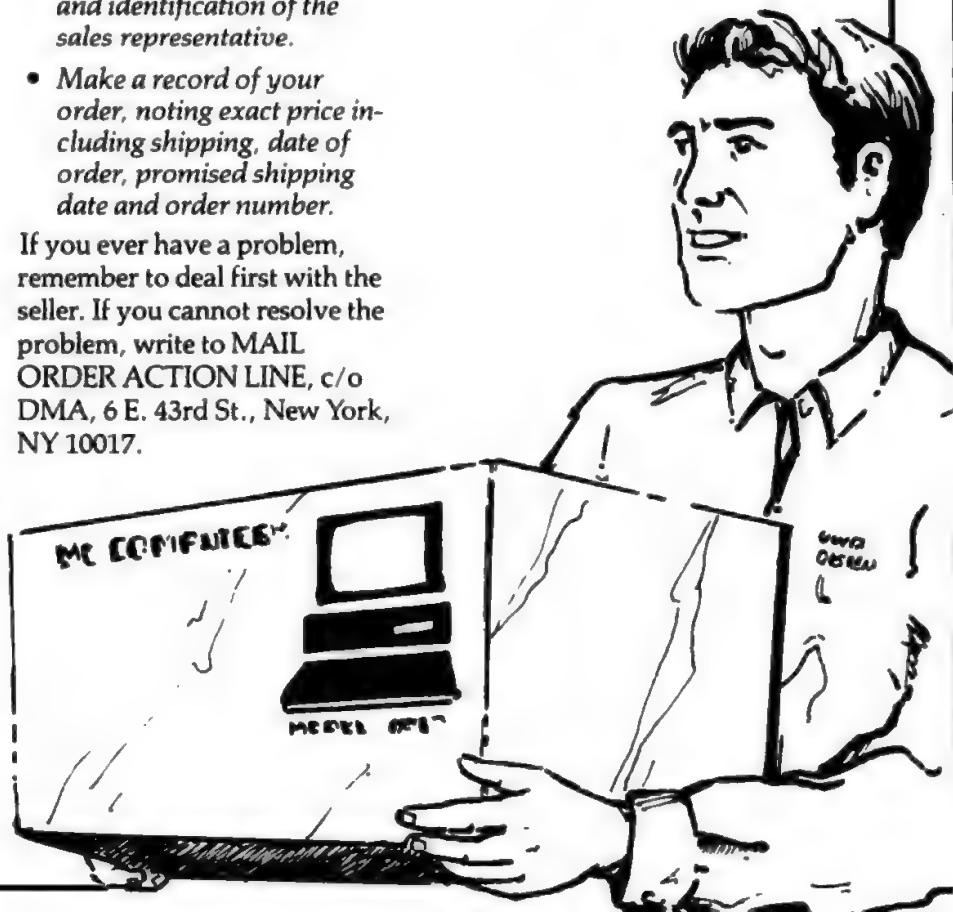
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Richard Hale Shaw

WSMOOTH Command

November 13, 1990 (Utilities)

Purpose:

A text-browsing utility, designed specifically for use in *Microsoft Windows 3.0*, that provides smooth, bidirectional scrolling at user-selectable speeds to ease reading from the screen. Its forerunner, SMOOTH.COM, performs the same function but is not intended for use in *Windows* unless run in the fullscreen.

Format:

WSMOOTH [filename] [msecs] [pixel rows] [/W]

Remarks:

WSMOOTH lets you use the mouse or the keyboard to display a file and control the scrolling speed. If you invoke SMOOTH without specifying a filename, a file-selection dialog box will be displayed. Once a file is selected, the program will immediately begin scrolling the file in its window. Scrolling direction is set using the Up and Down arrow keys or a single mouse click on the arrows on the vertical scroll bar. PgUp and PgDn flip a screenful at a time, and Home and End take you to the top or bottom of the file. The Spacebar or a single left mouse click will freeze scrolling, and a subsequent keystroke or mouse click will resume. You just exit WSMOOTH by pressing Esc, selecting Exit from the File or double-clicking the System icon.

The msec parameter lets you set the frequency at which WSMOOTH scrolls the screen. By default, msec is set to 100 milliseconds, so it will scroll about 10 times a second; a value of 1,000 will cause WSMOOTH to scroll approximately every second.

The pixel rows parameter (set to 1 by default) lets you adjust the number of rows of pixels scrolled, from 1 to 9. While scrolling, you can also control the number of pixel rows scrolled at a time in three ways: using the plus and minus keys; double- and single-clicking the right mouse button; or pressing one of the number keys. Zero brings WSMOOTH to a standstill; numbers 1 through 9 steadily increase the rate. Notice that WSMOOTH gets progressively less smooth as you increase the pixel-row setting toward 9.

The /W switch causes WSMOOTH to strip the high bit from each character before displaying it. This feature proves useful when viewing *WordStar* (or other) files that use the high bit to format the document. Try it if a document you're viewing occasionally appears to contain graphics characters.

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Utilities

WSMOOTH uses the already fast file-buffering it inherited from SMOOTH first to scan the entire file, counting the number of lines and length of each as it does so. Once it knows the number of lines in the file, WSMOOTH can use the SetScroll-Range function to establish a value that relates the vertical scroll bar to the number of lines in the file.

While this step might sound a bit tedious (after all, WSMOOTH has to do this every single time you display a different

The concept of scrolling one scan line at a time is relatively simple. It's when all the features come into play that WSMOOTH must use some of Windows' finer features to keep things rolling smoothly.

file), it isn't at all. The file buffering is so fast that on a 16-MHz 386 machine with a 24-ms. hard disk, WSMOOTH is able to scan files of up to 1.5MB in less than 2 seconds. With much smaller, conventional text files (64K to 128K), WSMOOTH can scan and display the file in almost no time at all.

As you can see, the concept of scrolling one scan line at a time is a relatively simple one. WSMOOTH's only requirements here are to call ScrollWindow and then repaint the invalidated portion of the display. It's when all the features—such as scrollbar interpretation, message handling, and large-file navigation—come into play that WSMOOTH must use some of Windows' finer features to keep things rolling along smoothly.

Richard Hale Shaw is a contributing editor of PC Magazine.

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CALL ABOUT A VIDEO TAPE DEMONSTRATION

by
Charles Petzold

Environments

I've gone on record asserting that the OS/2 Graphics Programming Interface (GPI) is one of the best graphics programming systems ever devised. I believe that my recent Environments columns substantiate this claim. In the past, I've explored some of the more interesting features of GPI, including Bezier splines, vector fonts, transforms, and metafiles.

In this issue, we'll take a look at the GPI *path*. A graphics path has nothing to do with a directory path, of course. The GPI path was adopted from PostScript. If you're familiar with PostScript programming, you already have a good idea of what this sort of a path is, because almost all drawing in PostScript uses paths.

A path is a collection of line definitions stored in memory internal to GPI. You create a path by calling GPI line-drawing functions within a "path bracket." You can then outline the path, "stroke" it with a thick line, fill the interior, use the interior for clipping, or convert the interior to a GPI region.

At first, the subject of paths seems rather simple, but upon closer inspection this proves not to be the case. The subject encompasses such concepts as "geometrically thick lines" and the two different fill modes supported in GPI.

THE PATH BRACKET

To define a path, you begin by calling `GpiBeginPath`:

```
GpiBeginPath (hps, 1L) ;
```

The second parameter to this function is a path ID, but it must always be equal to 1. (This parameter is a remnant from an early specification of GPI, which supported multiple path definitions.) Following `GpiBeginPath`, you can call various GPI functions—mostly line-drawing functions. You end a path definition with a call to

```
GpiEndPath (hps) ;
```

These two functions delimit a path bracket.

Drawing the Line In OS/2: Exploring The GPI Path

■ The OS/2 Graphics Programming Interface is one of the best graphics programming systems ever devised. Here's a look at the functions associated with the GPI path.

et. The GPI functions allowed within a path bracket are documented in Volume 1 of the Microsoft *OS/2 Programmer's Reference* (pages 482 and 483). In general, these are line-drawing functions such as `GpiMove`, `GpiLine`, and `GpiPolySpline`. Character-drawing functions (such as `GpiCharStringAt`) are also allowed if a vector font has been selected into the presentation space. None of these functions result in anything being drawn on the presentation space; instead, the line definitions are accumulated in the path.

Although GPI doesn't support multiple paths, it does support multiple *figures* in a single path. Each figure is actually a series of connected lines. You begin a new figure by making a call to `GpiMove` or to another function that will result in the current position being changed (such as `GpiSetModelTransformMatrix`). The figure continues with each call made to the line-drawing functions.

These figures may be either *open* or *closed*. A closed figure (in which the end point of the figure meets up with the beginning point of the figure) always ends with a

call to the following function:

```
GpiCloseFigure (hps) ;
```

This function is allowed only within a path bracket. The function causes a straight line to be defined from the current position to the beginning of the figure. You can't close a figure by drawing a line to the beginning of the figure; you must use `GpiCloseFigure`. We'll see shortly how GPI interprets open and closed paths.

Following the call to `GpiEndPath`, you can call one (and only one) of the following five functions:

```
GpiOutlinePath (1.2)  
GpiStrokePath (1.1)  
GpiFillPath (1.1)  
GpiSetClipPath (1.1)  
GpiPathToRegion (2.0)
```

(Following each of these function names is the version of OS/2 that first supports the function.)

Each of these functions does something with the path and then deletes the path. There is no `GpiDeletePath` function. After a call to one of these five functions, you can begin a new path definition by calling `GpiBeginPath` again.

THE PATHDEMO PROGRAM

To get a feel for how paths work, you might want to experiment with the `PATHDEMO` program. The following files for creating `PATHDEMO.EXE` are available on PC MagNet: `PATHDEMO.MAK`, `PATHDEMO.C`, `PATHDEMO.RC`,

Environments

PATHDEMO.H, PATHDEMO.DEF.
Use Microsoft C 6.0 to compile this program for OS/2 1.2.

The program draws three figures (two open and one closed) in a path bracket:

- The first figure is open and consists of two sides of a triangle.
- The second figure is also open, and consists of a triangle drawn without calling `GpiCloseFigure`.
- The third figure is closed, and consists of a triangle drawn with `GpiCloseFigure`. You can choose from the PATHDEMO menu what you want GPI to do with this path, as I'll describe here.

OUTLINING AND STROKING

The first two of the five functions that I listed earlier are `GpiOutlinePath` and `GpiStrokePath`. Both of these functions have

basically the same syntax:

```
GpiOutlinePath (hps, 1L, 0L) ;  
GpiStrokePath (hps, 1L, 0L) ;
```

The second parameter is the path ID (which must be set to 1) and the third parameter is a reserved value that currently must be set to 0.

Figure 1 shows `GpiOutlinePath` applied to the path definition in the PATHDEMO program, and Figure 2 shows `GpiStrokePath` applied to the path definition. As you can see, in both cases GPI draws a line on the path. However, the lines look quite different. The line that `GpiOutlinePath` draws is called a *cosmetic* line, while the one `GpiStrokePath` draws is called a *geometric* line.

COSMETIC AND GEOMETRIC LINES

These are the two different kinds of lines that GPI supports—*cosmetic* and *geometric*. The terms are a little strange—the

word *cosmetic* doesn't turn up very often in programming! But the distinction is quite useful.

There are three fundamental differences between cosmetic lines and geometric lines:

- Drawing a geometric line requires using a path. You can draw cosmetic lines with or without a path.
- The width of a cosmetic line is invariant under the GPI transforms. For example, if you use `GpiSetModelTransformMatrix` to zoom in on a cosmetic line, the width will not change. The width of a geometric line, on the other hand, is specified in world coordinates and is affected by all GPI transforms. If you zoom in on a geometric line, it appears thicker.
- A geometric line is treated more like a filled area than a line. Some attribute functions (such as `GpiSetLineType`) affect cosmetic lines but not geometric lines, while others (like `GpiSetPattern`) affect geometric lines but not cosmetic lines.

A cosmetic line is the type of line you'd use for normal drawing, using GPI drawing functions. Indeed, calling `GpiOutlinePath` on a path definition is generally equivalent to simply drawing the lines without using paths at all. (However, if you have a vector font selected in the presentation space and call one of the text output functions in the path definition, then `GpiOutlinePath` will cause the characters to be outlined.)

The width of a cosmetic line is specified by the `GpiSetLineWidth` function. In OS/2 1.1 and 1.2, this function had no effect. However, beginning in OS/2 2.0, you can use the parameter `LINEWIDTH_NORMAL` (to draw a normal line) or `LINEWIDTH_THICK` (to draw a line twice the width of a normal line).

The appearance of a cosmetic line is specified by the `GpiSetLineType` function. This function allows you to draw lines composed of dashes and dots.

A geometric line can be drawn only by using a path, generally by calling the `GpiStrokePath` function. (We'll see an alternative to this later.)

The `GpiSetLineWidth` and `GpiSetLineType` functions have no effect on geometric lines. Instead, the width of a geometric line is governed by the `GpiSetLineWidthGeom` function. This line width is specified in world coordinates. You can also specify the *ends* and *joins* of these lines using `GpiSetLineEnd` and `GpiSetLineJoin`. The `GpiSetLineWidthGeom`, `GpiSetLineEnd`, and `GpiSetLineJoin` functions have

Figure 1: Here the PATHDEMO program uses `GpiOutlinePath` to draw a cosmetic line. You can actually draw cosmetic lines without a path.

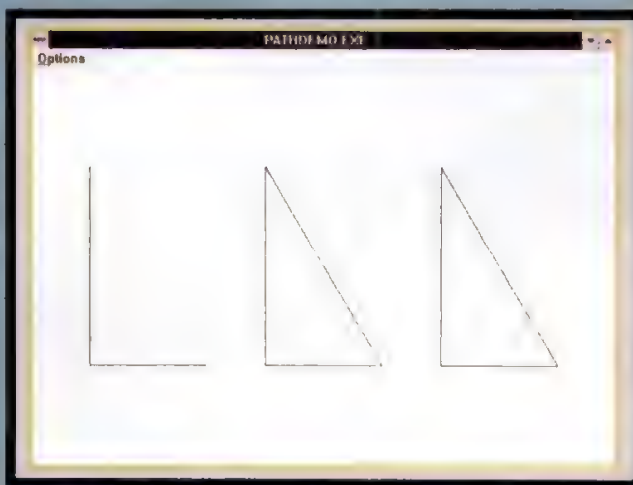
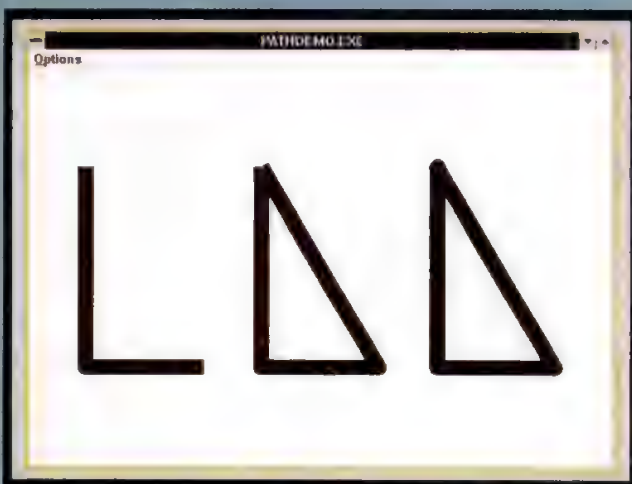


Figure 2: The `GpiStrokePath` function is used here to draw a geometric line. A geometric line is treated more like a filled area than a line.



Environments

no effect on cosmetic lines.

GPI fills the interior of a geometric line using the currently selected area-filling pattern specified by `GpiSetPatternSet` and `GpiSetPattern`. This allows you to draw geometric lines filled with various types of hatch marks or dot densities.

Using the `GpiSetAttrs` function to set GPI attributes works a little differently for cosmetic lines and geometric lines.

For setting the attributes of cosmetic lines, you use the `IColor`, `usMixMode`, `fxWidth`, and `usType` fields of the `LINEBUNDLE` structure.

For setting attributes of geometric lines, you use the `lGeomWidth`, `usEnd`, and `usJoin` fields of the `LINEBUNDLE` structure. The color and mix mode of the geometric line (as well as the filling pattern) are specified using the `AREABUNDLE` structure.

As I said, the distinction between cosmetic lines and geometric lines is very useful. For example, suppose you were using GPI for an architectural drawing of a building. You'd use geometric lines for the walls of the building, because the walls have a real-world width. When you zoom in on the drawing, the walls would appear to be wider. But you'd use cosmetic lines for the dimension lines of the drawing. There's no reason for these lines to be thicker when zooming in.

You should use geometric lines with discretion, and only when you need them. There's a simple reason for this rule: performance. GPI draws cosmetic lines much faster than geometric lines.

ENDS AND JOINS

Once you begin drawing geometric lines that have a real-world width, you become more concerned about the appearance of these lines. In particular, you may want the ends of these lines to be flat or rounded.

The geometric line end is specified by the `GpiSetLineEnd` function:

```
GpiSetLineEnd (hps, lLineEnd) ;
```

The `lLineEnd` parameter can be one of the following: `LINEEND_DEFAULT` (which is the same as `LINEEND_FLAT`), `LINEEND_FLAT`, `LINEEND_SQUARE`, or `LINEEND_ROUND`. The end of the line is flat when either `LINEEND_FLAT` or `LINEEND_SQUARE` is specified, but the

square line end causes the line to be extended by half its width. The round line end is a half-circle drawn at the end of the line.

You can also govern how two connected lines are joined:

```
GpiSetLineJoin (hps, lLineJoin) ;
```

The `lLineJoin` parameter can be one of the following: `LINEJOIN_DEFAULT` (same as `LINEJOIN_BEVEL`), `LINE-`

You should use geometric lines with discretion. There's a simple reason for this rule: performance. GPI draws cosmetic lines much faster than geometric lines.

`JOIN_BEVEL`, `LINEJOIN_ROUND`, `LINEJOIN_MITRE`. (Note the British spelling in `LINEJOIN_MITRE`.) The miter line join connects the lines with a pointed edge; the bevel line join shaves off the point.

When drawing geometric lines using `GpiStrokePath`, the `PATHDEMO` pro-

gram sets the geometric line width to 1/32 of the average width and height of the client window. The line end is set to `LINEEND_FLAT`, and the line join is set to `LINEJOIN_ROUND`.

Look very closely at the top of the second and third figures. You'll recall that the third figure was drawn using the `GpiClosePath` function, while the second was not. In the second figure, the beginning and end of the line (at the top of the figure) is treated as a line end, and thus is drawn with overlapping flat ends. In the third figure, `GpiClosePath` causes the two lines to be joined at the top, so it is drawn with a round join.

FILLING THE PATH

The third of the five functions I listed above for using a path is `GpiFillPath`:

```
GpiFillPath (hps, lL, lFill) ;
```

The third parameter can be either `FPATH_ALTERNATE` or `FPATH_WINDING` for the fill mode. GPI will close any open figures and fill them with the current area pattern. As you can see in Figure 3, all three figures are treated identically by `GpiFillPath`, and it doesn't matter whether you use the alternate or winding fill mode. (The program allows you to specify either.)

`GpiFillPath` used on a path is very similar to using `GpiBeginArea` and `GpiEndArea` to define a filled area. However, even if you have a vector font set in the presentation space, you can't call one of the text output functions in an area bracket. `GpiFillPath` allows you to fill the interior of vector font characters with a pattern.

The fill mode affects figures whose

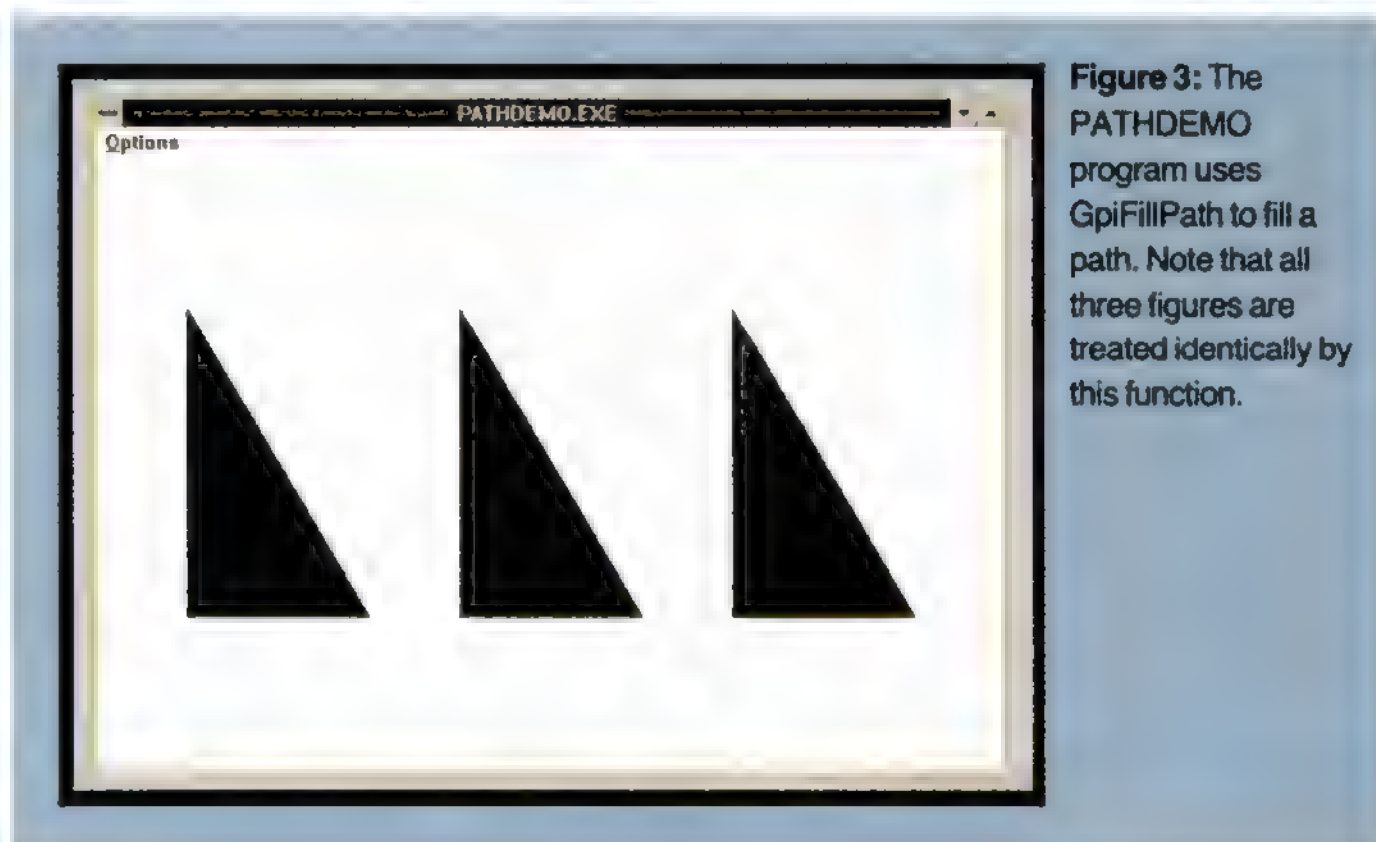


Figure 3: The `PATHDEMO` program uses `GpiFillPath` to fill a path. Note that all three figures are treated identically by this function.

Environments

lines may intersect. With the alternate fill mode, an enclosed area is filled if an imaginary line drawn from the area to infinity crosses an odd number of boundary lines. With the winding fill mode, an enclosed area is filled if an imaginary line drawn from the area to infinity crosses an equal number of lines going in opposite directions. (A more extensive discussion of these fill modes can be found on pages 197 to 205 of my book *Programming the OS/2 Presentation Manager*.)

The two remaining functions, `GpiPathToRegion` and `GpiSetClipPath`, are not demonstrated by `PATHDEMO`, but they are sufficiently similar to `GpiFillPath` that you'll be able to understand how they work. The first function creates a region out of a path, making the region the same as the filled path:

```
hrgn = GpiPathToRegion (hps, 1L,  
    1Fill);
```

This function is new with OS/2 Version 2.0. As with `GpiFillPath`, the third parameter can be set to either `FPATH_ALTERNATE` or `FPATH_WINDING`. The region (which is converted to device coordinates) can then be used with any of the GPI region functions. The last of the five functions—`GpiSetClipPath`—defines a clipping path in world coordinates. The function can be used in either of two different ways. The first is

```
GpiSetClipPath (hps, 0L,  
    SCP_RESET);
```

This resets the clipping path to no clipping. The second form of the function

```
GpiSetClipPath (hps, 1L,  
    SCP_AND | 1Fill);
```

causes the clipping path to be set to the intersection of the current clipping path and the filled path. For the `1Fill` parameter you can use either `SCP_ALTERNATE` or `SCP_WINDING`. Following the use of this function, any drawing will occur only within that particular area set by the clipping path.

MODIFYING THE PATH

There is one final path function I haven't mentioned yet, `GpiModifyPath`. You call

this function after the path definition (or in other words after `GpiEndPath`) but before one of the five path functions that I described earlier. The syntax for `GpiModifyPath` is as follows:

```
GpiModifyPath (hps, 1L,  
    MPATH_STROKE);
```

The second parameter is the path ID (which must be set to 1) and the third parameter must currently be set to `MPATH_STROKE`. The function modifies the path as follows:

- Any open figure in the path is converted to a closed figure based on the geometric line width, line end, and line join.
- Any closed figure is converted to two closed figures, again based on the geometric line width and line join (but not the line end, because, of course, a closed figure has no end).

The documentation implies that this function may not be used prior to `GpiOutlinePath` and `GpiStrokePath`. As `PATHDEMO` demonstrates, this is not true, and it makes for some interesting effects. You can enable `GpiModifyPath` using the `PATHDEMO` menu. The program defines a geometric line width of 1/16 the average of the width and height of the client window, a round line end, and a mitered line join.

Figure 4 shows what happens when you call `GpiModifyPath` followed by `GpiOutlinePath`. In the first and second figures (which were originally open), the path is now closed and defines the outline of a geometrically thick line. The third figure (which was closed) becomes two closed figures—one for each side of the geometrically thick line.

This new path can then be stroked with a geometrically thick line using `Gpi-`

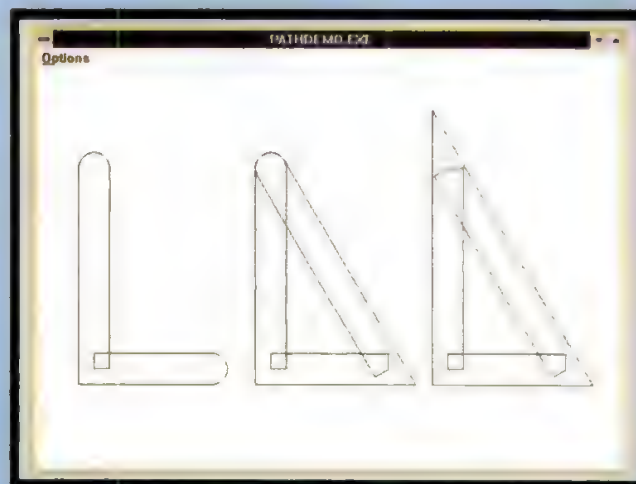


Figure 4: The `PATHDEMO` program shows here what happens when you call `GpiModifyPath` followed by `GpiOutlinePath`.

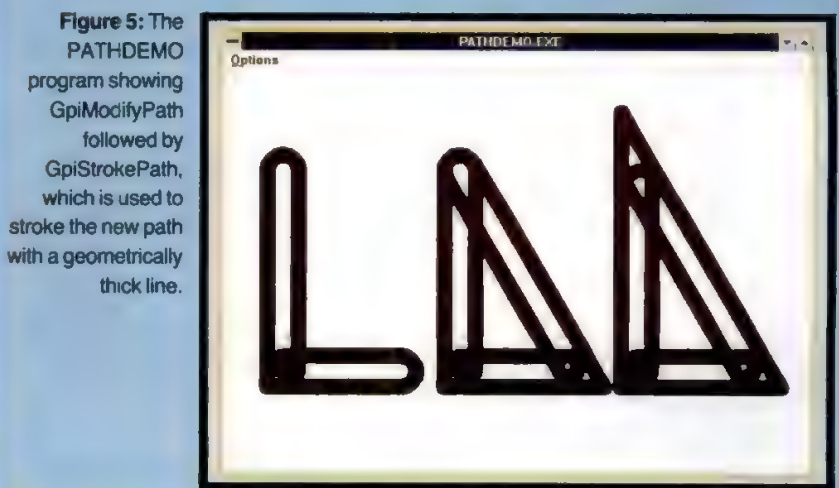


Figure 5: The `PATHDEMO` program showing `GpiModifyPath` followed by `GpiStrokePath`, which is used to stroke the new path with a geometrically thick line.

Environments

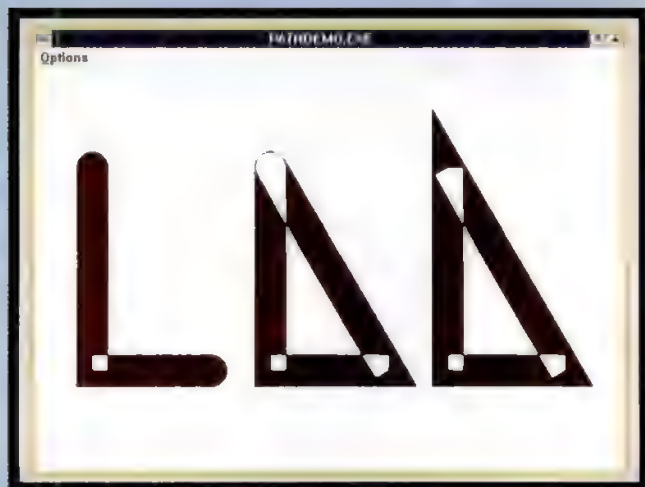


Figure 6: The PATHDEMO program showing GpiModifyPath followed by GpiFillPath with the alternate fill mode.

Figure 7: The PATHDEMO program showing GpiModifyPath followed by GpiFillPath with the winding fill mode.



StrokePath, as shown in Figure 5. There are two different sets of geometric line widths, line ends, and line joins at work here—the first set used for GpiModifyPath and the second set used for GpiStrokePath.

Figures 6 and 7 show GpiModifyPath followed by GpiFillPath using the alternate and winding fill modes, respectively. GpiModifyPath followed by GpiFillPath with the winding fill mode is equivalent to GpiStrokePath, as you can see by comparing Figures 2 and 7. (These two figures are not identical, because they use different geometric line widths, ends, and joins.)

In theory, you can call GpiModifyPath any number of times before one of the five path functions, but you'll quickly hit a limit of path complexity and encounter a PMERR_PATH_LIMIT_EXCEEDED error.

NORMAL USES OF PATHS

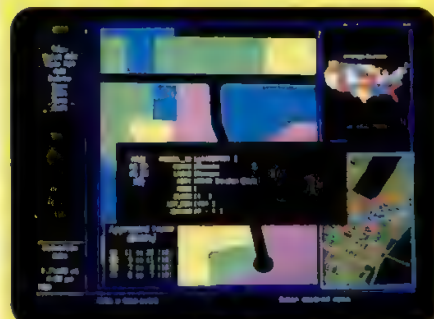
As usual, GPI provides a bit of redundancy, so it may help to summarize the customary ways you'll use paths in your Presentation Manager programs:

- To draw a geometrically thick line, use GpiStrokePath.
- To fill an area defined by lines, you can use GpiFillPath. (However, using an area bracket instead is a little easier, because it requires one less function call.)
- When using vector fonts to create some interesting effects, you can use GpiOutlinePath to outline the font characters, GpiStrokePath to outline them with a geometrically thick line, GpiFillPath to fill them with a pattern, GpiSetClipPath to restrict drawing to the interior of the characters, or GpiPathToRegion to convert the interior of the characters to a region.

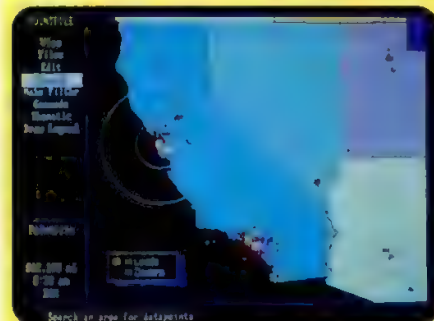
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by
Ray Duncan

Power Programming

Redefining the Programming Paradigm: The Move Toward OOPLs

At first glance, C appears to be riding the crest of a tremendous wave of popularity. The ANSI and ISO standards for C have passed the final milestones for approval, many of the most important PC applications either have been or are being ported to C from their original implementation language, and the advertisements for C-oriented tools and libraries in programming magazines outnumber those for all other languages put together. But I suspect that within a relatively few years we'll be discussing ANSI C with nostalgia and its remaining advocates with amused tolerance—much as many programmers now view COBOL, FORTRAN, and BASIC.

This prediction is based on two facts. First, once a language is standardized, its evolution is placed at the mercy of ANSI's strict requirements for political consensus and compatibility with existing practice, as well as the ANSI five-year review cycle. The language can no longer adapt rapidly to changes in programming methodology or the demands of new operating environments. At some point, when the requirements of the real world diverge enough from the facilities provided by the language, it becomes easier for programmers to switch to another language or invent a new one.

Second, and more importantly, it's clear that a massive shift in programming paradigms is on the way. Our tidy little world of traditional procedural programming languages is about to be turned upside down, and the new victor will be the object-oriented programming languages (OOPLs). Such upheavals are not without precedent—the replacement of FORTRAN with modern, block-structured languages such as Pascal, C, and Modula II over the last decade comes immediately to mind. But the transition to OOPLs will have a much more dramatic impact on programmers than switching from FORTRAN to C.

Why? Because OOPLs require the programmer to look at the problem he is trying to solve in a radically different way. In tra-

■ Our tidy little world of traditional, procedural programming languages is about to be turned upside down, and the new victor will be the object-oriented programming language.

ditional languages, you visualize the data to be worked on as sitting in one place, while various routines call upon each other to do things to the data. In an object-oriented programming environment, the routines are visualized as static—hidden inside little black boxes called *objects*—and it is the data that is lively: it flits from one object to another in the form of *messages*. This has an interesting correspondence with graphical environments such as the Macintosh's, *Microsoft Windows*, and OS/2 Presentation Manager, as we'll see later.

THE LINEAGE OF THE OOPLS

In spite of the recent fuss and flurry of magazine articles and books about object-oriented programming languages, the OOPLs are not exactly a new invention. The prototypal OOPL, Simula, was first described in 1967—it actually predates the C language. Simula (originally called Simula 67), was invented by Ole-Johan Dahl and Krysten Nygaard at the University of Oslo and the Norwegian Computing Center. The more widely known Smalltalk language was developed in the mid-1970s

at Xerox's legendary Palo Alto Research Center (PARC) by Adele Goldberg, Alan Kay, Daniel H. H. Ingalls, and others. Other early OOPLs included Object Pascal, DEC's Trellis/Owl, and some LISP derivatives called Loops, Flavors, and Ceyx.

The key event in bringing OOPLs to the masses was the invention of C++ about eight years ago by Bjarne Stroustrup, a researcher at AT&T Bell Labs. C++, an object-oriented superset of C, quickly found favor among academicians and certain C systems programmers. The features of C++ that distinguished it from its OOPL predecessors such as Smalltalk were its backward compatibility with existing C code—allowing programmers to learn and adopt object-oriented techniques in an incremental fashion—and its implementation as a true compiler rather than an interpreter. A C-based alternative to C++, called Objective C, was designed by Brad Cox at around the same time as Stroustrup's original work. But the Objective C extensions were more similar to Smalltalk and less intuitive for C programmers. Objective C has also been handicapped by its lack of an endorsement from AT&T and now seems to be something of a dead issue.

Some of the characteristics of Smalltalk and the original C++ compilers illustrate why the OOPLs were regarded as curiosities by the vast majority of programmers for so many years. A complete Smalltalk environment demands a powerful machine with a high-resolution graphics adapter, megabytes of RAM, and a large, fast,

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fixed disk. Only very recently have such machines come within the financial reach of the average programmer. In addition, the strengths of Smalltalk—an interactive browse-oriented environment, with all source code on-line and instantly accessible for change—have also proven to be weaknesses when the language is used for large projects involving many programmers. There's nothing to stop the creative programmer from customizing the system almost past recognition; indeed, there's nothing to stop him from modifying vital objects in the Smalltalk system in such a way that the system quits working altogether! Using Smalltalk is also problematic if the objective is the generation of small, turnkey applications that don't require megabytes of RAM to run.

C++ struggled through the 1980s with a reputation for slow, buggy, clumsy compilers that generated bulky, inefficient machine code. Most C++ compilers simply translated C++ source code into incredibly tortuous C source code, which was then fed to the system's ordinary C compiler. Naturally, the original versions of C++ didn't support integrated programming environments with class browsers, syntax-directed editors, and all the other goodies of a Smalltalk development system either. Programmers were skeptical about committing to C++ for large development projects, because the language was rapidly evolving, several dialects were floating around from different compiler vendors, and the picture was further confused by the existence of Objective C and the deliberations of the ANSI C committee (which ended up incorporating some C++ features into the C language).

Object-oriented programming sputtered along, accumulating a core group of users and advocates, but serving primarily as a topic for academic seminars and graduate student theses, until May of 1989. During that month, both Borland and Microsoft jumped on the OOPL bandwagon by introducing integrated Pascal programming environments with object-oriented extensions. The coincidence of timing and degree of resemblance between the Microsoft QuickPascal and Borland Turbo Pascal 5.5 announcements was truly uncanny. The two products were released within a week of each other. Both were 100 percent upward compatible from

Turbo Pascal 5.0 and included excellent documentation, extensive on-line reference materials, windowed multifile editors, and an integrated debugger. And both packages reached programmers at street prices of less than \$100. This was truly a milestone, because it put OOPL capabilities in the hands of literally millions of serious and casual programmers but didn't force programmers to explore those capabilities until they were ready.

In May of 1990, Borland blew the OOPL market wide open when it released Turbo C++, a natural evolution of its popular Turbo C product. Turbo C++ is a fully integrated C++ environment that in-

**The arrival of Borland's
Turbo C++ guarantees
that the era of OOPL is
finally upon us.**

cludes a compiler, editor, debugger, browser, profiler, and assembler. It's upward compatible from ANSI C, so that the programmer can continue to use all his old source code as he learns OOPL techniques, and Turbo C++'s user interface, documentation, and robustness are all typical of Borland's high standards. The arrival of this product guarantees that the Era of OOPL is finally upon us.

CHARACTERISTICS OF OOPLS

The reversal in viewpoint that you undergo to write programs with an OOPL is very similar to the painful adaptation that MS-DOS programmers endure when they start coding for a windowing environment such as the Macintosh's, *Microsoft Windows*, or OS/2 Presentation Manager. MS-DOS programmers are accustomed to the idea that nothing happens unless their program makes it happen—for instance, no character arrives from the keyboard unless and until the program requests one. But in a windowing environment, a program must be constructed much differently, because it is constantly and unpredictably bombarded with unsolicited *events* ranging from mouse movements to requests by the operating system to repaint part of the screen. No matter what other work the program might be doing, it's always expected

to handle the events in a timely manner. Similarly, an *object* in an OOPL is never acting, it's always reacting.

What marks a programming language as truly object-oriented? The three classic features that are always cited in this connection are encapsulation, polymorphism, and inheritance. Remember these three buzzwords—they'll serve you well when you're evaluating the claims of language vendors, impressing your friends at parties, or trying to confound the attempts of your managers to figure out what you are doing.

Encapsulation is a fancy term for information hiding. As we mentioned, when you write a program in an OOPL, procedures, their private data, and constants are enclosed within entities called objects. Each object "knows" which messages it can process, which it should reject, and which it should pass on to another object—but no object can truly know the capabilities of another. Each object is an instantiation of an object type or class; the members of a class have different names but symmetric capabilities. The primary goal of encapsulation is the insulation of a particular object class's internal workings so that it can be modified and improved without causing harmful side effects elsewhere in the system.

Polymorphism is similar to the operator overloading you find in C or Pascal, where you can use the same operator to manipulate several different data types: the C or Pascal compiler is smart enough to examine the data types and generate the appropriate code. In an OOPL, polymorphism refers to an object's capability to select the correct internal procedure (called a method) based on the type of data received in a message. For example, a Print object might be sent a message containing a binary integer, a binary floating-point number, or an ASCII string; in an OOPL, you have a right to expect the object to take the appropriate action (or at least fail gracefully) even if the contents of the message aren't known at the time you write the program.

Inheritance is the OOPL's major weapon against complexity, and the feature that makes it especially appropriate for programming windowing environments such as the Macintosh's or OS/2 Presentation Manager. A new class of objects is derived from an existing class by changing one or more of the older class's methods and adding one or more new methods. This process is sometimes called subclassing. The new class need only contain the actual

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code for added or changed methods; the code for methods that are "inherited" unchanged from the parent class remains in the parent; messages not handled by a class's unique methods are automatically routed to its parent. You can easily imagine how this simplifies coding a program that must control many different types of windows that are minor variants on each other: client windows, pull-down menus, dialog boxes, and so on.

BEYOND THE VALLEY OF THE OOPLS

While the transition to OOPLs may be perplexing and intimidating to most of us workaday programmers, the eventual triumph of OOPLs in one form or another seems inevitable now, since it will be driven by the difficulty of programming graphical user interfaces in traditional, procedural languages. Indeed, at last year's Microsoft Systems Seminar, the speakers took the impending dominance of OOPLs completely for granted and were talking instead about Microsoft's plans for object-oriented file systems and object-oriented user interfaces! What in the world can these things be?

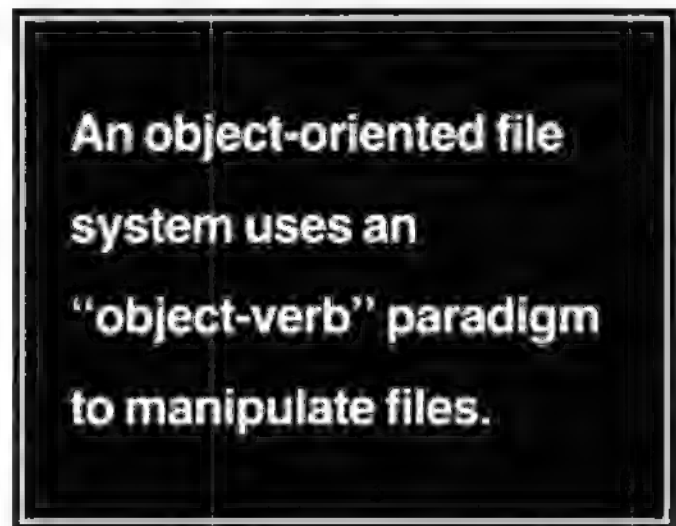
Well, let's begin with the idea of an object-oriented file system. In the old, familiar, command-line-oriented MS-DOS file system, you use a "verb-object" approach to manipulation of data files. First you invoke an application program capable of performing certain operations on data that's in a specific format, then you pick a file of data appropriate to the application. If, perchance, you select the wrong type of data file, most programs will display garbage, do something totally unexpected, or even crash.

In contrast, an object-oriented file system uses an "object-verb" paradigm to manipulate files—first you select a file or files, then an operation (open, print, copy, delete, and so forth). In OOPL terms, data files are the objects and application programs are the methods. Conceptually, a menu selection sends a message to program code associated with a particular class of file, and that code decides whether and how it can carry out the requested action. You can get an idea of how this works by looking at the Macintosh Finder. In the Finder, you can delete a file by clicking on its icon and then dragging it to the trash can (in effect, sending the message "delete

yourself" to the file); or double-click on a data file, causing the application that originally created the file to be loaded and executed.

The High Performance File System (HPFS) of OS/2, Version 1.2, has been specifically designed to serve as the platform for an object-oriented file system. The main vehicle for implementing object-oriented characteristics is a new feature called extended attributes (EAs). EAs can be associated with a file or an arbitrary path and are conceptually similar to environment variables, each EA taking the form name=value.

In OS/2 1.2, each file can have up to 64K of EAs, which are stored outside the



An object-oriented file
system uses an
"object-verb" paradigm
to manipulate files.

file itself. The important point is that the value of an EA can be an ASCII string or binary data. The binary data might be an icon, an encryption key, or even executable code. For example, a document file created with *Microsoft Word*, Version 5.0, might have the following EAs associated with it (among others):

```
ICON=<binary bitmap>
APP_NAME=Microsoft Word
APP_VERSION=5.0
APP_EXE=WORD.EXE
```

The shell could then use the EA ICON= to display an icon that represents the file on the "desktop". When the user requests a detailed directory listing, the shell can use the EAs to display information about the data file's "owner application" without needing to peer inside the file and interpret its contents. If the user double-clicks on the document file's icon, the shell could use the EA APP_EXE= to locate and launch the application program that knows how to process the data, and so on.

Once the framework for an object-oriented file system is in place, Microsoft plans to extend its capabilities throughout networked environments. The user won't need to know in which node a data file or

application is located, and the data and the programs will not need to reside in the same network node either. The file system and network will collaborate to find the data file, move the data where it is needed, run the application on any available network node that has the required hardware resources, and finally return the results to the user's node.

As for object-oriented user interfaces, Microsoft gave us a preview of what's in store in this area by demonstrating an experimental user interface toolkit for *Windows 3.0*. The toolkit allows a user to build his own customized shell by *visual programming*. Not a line of code need be written; the new shell is designed solely by choosing items from menus, by interacting with dialog boxes, and by selecting, dragging, and resizing visual objects such as window frames, scroll bars, and disk drive icons. When the appearance of the user's new desktop is exactly to his liking, he simply saves the configuration and it becomes the default shell for his machine's copy of *Windows* from that point on.

In addition, Microsoft announced intentions to market programming tools that allow a similar type of visual programming for building *Windows* and Presentation Manager applications. User interfaces will be constructed by the programmer, using an interactive graphical design tool that will automatically generate the necessary program source code for the application program's skeleton. This will eliminate the need to write hundreds of lines of obscure C code just to select fonts, scroll windows, and control menus and dialog boxes, and will allow programmers to concentrate on the core of the application rather than the mechanics of the user interface. The NeXT machine is already being supplied with these programming tools.

Finally, Microsoft discussed its plans to implement and support a system-level macro language that will allow users to drive application programs "from the outside" and transfer data between them. Microsoft's new language will apparently be a superset of QuickBasic, with the same sorts of control structures and operators. The user will be able to create scripts in this macro language by instructing the system to "watch me" and then simply carrying out the desired steps in order. The user will then be able to fine-tune and elaborate on the scripts with a normal text editor. A facility like this is sorely needed in a graphical environment, where traditional batch languages are essentially useless.

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SOMETHING TO READ

Perhaps you care to explore the OOPL literature before venturing into the world of OOPL programming? I must warn you that the market is swamped with trade books on the subject, and (to paraphrase a famous statistical assertion) 90 percent of them are fit only for the recycling bins. A surprisingly conspicuous example is Stroustrup's original book, *The C++ Programming Language* (Addison-Wesley Publishing Company, Reading, Mass., 1986, ISBN 0-201-12078-X), which is at one stroke one of the ugliest and most incomprehensible language primers ever published. I suppose that Addison-Wesley was so awestruck by Stroustrup that they didn't even subject the manuscript to the usual developmental editing. They also, unfortunately, allowed the author to do his own book design and typesetting—with predictable results.

If your taste runs to the object-oriented derivatives of C and Pascal, you might want to take a look at *Object-oriented Software Construction*, by Bertrand Meyer (Prentice Hall, New York, New York, 1988, ISBN 0-13-629049-3). This is a rather formal text, even a bit stuffy at times, but it's very clearly written. The primary language used in the book is Eiffel, an invention of the author, but other OOPLs such as C++, Object Pascal, Simula, and Smalltalk are also surveyed and compared.

On the other hand, if you are drawn to the original, pure OOPLs such as Smalltalk, you should browse through the three Addison-Wesley volumes written and edited by the original Smalltalk developers: *Smalltalk-80; Bits of History, Words of Advice*, edited by Glenn Krasner (Addison-Wesley, 1983, ISBN 0-201-11669-3); *Smalltalk-80; The Language and Its Implementation*, by Adele Goldberg and David Robson (1983, ISBN 0-201-11371-6); and *Smalltalk-80; The Interactive Programming Environment*, by Adele Goldberg (1984, ISBN 0-201-11372-4).

THE IN-BOX

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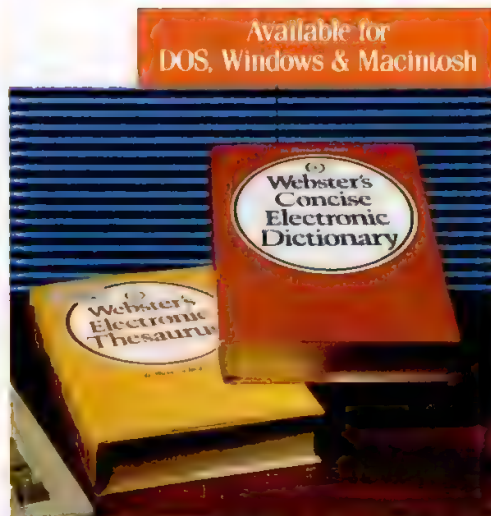
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by
William S. Hall

Windows

COM3 AND COM4 IN WINDOWS 3.0

Recently I decided to install a third communications port on my 386 machine, since the *Windows* 3.0 communications driver now supports COM1 through COM4. I had no trouble addressing the port in real and standard modes, but difficulties popped up in 386 enhanced mode.

While DOS has always supported more than two communications ports, only COM1 and COM2 have standard addresses and hardware interrupt levels (IRQ): COM1 uses IRQ4 and address 03F8h; COM2 uses IRQ3 and address 02F8h. You can see these addresses by examining the BIOS data area. To do this, run DEBUG and type

```
'd 40:0'
```

A line similar to

```
0040:0000  F8 03 F8 02 00 00  
00 00 ...
```

will be displayed. The first 4 bytes are loaded automatically at boot-time. Taken two at a time, they are the respective addresses of COM1 and COM2 in the standard Intel byte-reversed order.

The next 4 bytes can accommodate two more addresses—the ones for COM3 and COM4. I loaded my address for COM3 (02E8h) into the next 2 bytes at 40:4 using a text file, COM.TXT, containing the DEBUG commands

```
E40:4 E8 02  
Q
```

The instructions initiate the Enter (E) command beginning at 40:4, change the next 2 bytes, and then exit. To use the file, I redirected it to DEBUG using the following command:

```
debug < com.txt
```

If you happened to have both COM3 and COM4, then you would add the two

■ **COM3 AND COM4 IN WINDOWS 3.0:** You can address these ports in standard and real modes without problem, but you may find some surprises in enhanced mode.

■ **AN OLD FACE FOR THE NEW WINDOWS:** stuck in old habits? Change the *Windows* 3.0 default to the MS-DOS Executive.

■ **FORMATTING DISKS FROM WINDOWS:** With *Windows* 3.0 you can format low-density disks without having to look at the DOS prompt.

■ **TRACKING PRINTER DRIVERS:** The new *Windows* might ignore your old printer, but other applications can steer you to the right driver.

values for COM4's address in reverse order. For example, using 02E0h (again, this is my address for COM4), COM.TXT would look like this:

```
E40:4 E0 02 E0 02  
Q
```

Note that if you are on an ISA machine, you will not be able to use the pairs COM1 and COM3 or COM2 and COM4 simultaneously, because each pair shares the same interrupt level. However, on an EISA or Micro Channel computer (where the interrupts are level and not edge triggered) interrupts can be shared.

COM3 installed, I ran Columbia University's *Kermit* program (which is capable of using all four ports) to test the setup from DOS. The COM port had no prob-

lems reaching a remote computer.

I also made successful connections when I executed the same test in real and standard mode first using *Windows*' Terminal program and then from the DOS shell.

I ran into problems, however, when I tried the test from enhanced mode. Terminal ran just fine on COM3, but from the DOS shell executed from within *Windows*, the port failed. The characters were being sent, but there was no ECHO on the screen. Clearly, the port address was correct, but the interrupt was not set. I exited DOS, entered Terminal, and tried the test once again—this time the port failed even from the *Windows* environment. The situation did not improve after exiting *Windows* altogether, and I had to cold-boot the machine to get things back to normal.

This seemed strange, so I opened the SYSINI2.TXT, a readme file that gives procedures for modifying SYSTEM.INI settings. Under the [386ENH] section, I found a number of settings for the addresses and interrupt levels of all four ports, along with the default values. But no amount of fiddling with these changed my enhanced-mode test results.

The conclusion? Once you set the appropriate port values for COM3 and COM4, beginning at 40:4, you will have complete functionality (with the restrictions about sharing mentioned above) in real and standard mode, but in enhanced mode, you must confine any communications activities in a DOS shell to COM1 and COM2. From *Windows* you can use COM3 and COM4 as well.

EISA and Micro Channel computers generally have better handling of COM3 and COM4. So if you're using one of these machines, as well as three or four ports, let me know how you're faring.

AN OLD FACE FOR THE NEW WINDOWS

While *Windows* 3.0 offers a better working environment than *Windows* 2.x, I found that the Program Manager and File Manager do

Windows

not provide a true replacement for the old MS-DOS Executive shell. The Program Manager is well-suited to a stable PC environment, but it will recognize only files that are added to groups. Furthermore, the Program Manager is *not* meant to provide directory view of the computer's hard disk.

The File Manager, with its file-attribute adjustment and file moving, is more powerful than the MS-DOS Executive, but at the same time it lacks certain MS-DOS Executive features. For example, several instances of the MS-DOS Executive can be spawned, with each one showing the root directory of a different drive. The File Manager, on the other hand, permits only one drive to have a tree view. Moreover, the MS-DOS Executive offers a more Spartan view, with each instance having only one window. The File Manager, however, clutters up the screen with a new window for each subdirectory.

Fortunately, *Windows 3.0* offers a choice of shells. When I looked into replacing the Program Manager (PROGMAN.EXE) shell, I discovered the file MSDOS.EXE. Simply call up the SYSTEM.INI file and enter the desired shell on the line labeled

```
SHELL=
```

So by specifying

```
SHELL=MSDOS.EXE
```

I can now establish the old MS-DOS Executive as the default environment. If I need the File Manager, I can run WINFILE.EXE, and if I need the Program Manager, I can run PROGMAN.EXE. Like the infamous C: prompt, MS-DOS is very much alive and kicking.

Evan Brody

Staten Island, New York



As Mr. Brody has observed, the Program Manager is not the only shell that can be used in *Windows*. But you don't need to establish the MS-DOS Executive as the default. As an alternative, you can add the older environment to the Program Manager as an icon; the Main group is a suitable location. This way you can continue to use the Program Manager as your main shell while keeping the MS-DOS Executive on hand as a utilitarian

an alternative to the File Manager.

In the days of *Windows 2.x*, the MS-DOS program was much maligned for its less-than-snappy appearance and incomplete set of file management commands. A few companies stepped in and began to offer useful alternatives, many of which have been put aside with the advent of *Windows 3.0*. Nevertheless, now that the euphoria of the new *Windows* has passed, it is clear that both the Program Manager and File Manager have some limitations. The File Manager seems especially clumsy to use, and many users carry out file tasks through a DOS shell. At least one—*File Manager* from Distinct Corp. in Sara-

It is clear that both the
Program Manager and
the File Manager have
some limitations.

toga, California—is available as a marked 2.0 application, so it also works very well in *Windows 3.0*. hDC also has some offerings in this area.

By the way, another "hidden" program you may want to add to a program group is SYSEDIT.EXE, which you'll find in the SYSTEM subdirectory of *Windows*. SYSEDIT is simply a notepadlike editor that automatically loads all the .INI files to be viewed at once. It is useful for modifying those fields in WIN.INI, SYSTEM.INI, and so on, that cannot be adjusted by means of a dialog box.

FORMATTING DISKS FROM WINDOWS

I've been a fan of *Windows* for two years and have always wanted to configure my system so that I would never have to use DOS. With the advent of *Windows 3.0* enhanced mode, I can finally do this.

I often format low-density disks in high-density drives. Unfortunately, the File Manager uses the high-density default. So to format low-density disks, you must add the proper parameters to the format command. To do this, first set up two PIF files, one for drive A: and one for drive B:. I call them FORMATA.PIF and FORMATB.PIF. In the first, add the parameter A: /4 which formats a disk as 360K in a 1.2MB drive. Note

that /F:360 is an alternative to this parameter in DOS 4.x. In the second, add the parameter B: /N:9. (Note: since both 1.4MB and 720K disks use 80 tracks, the /T: parameter isn't needed.) For both, select the options that allow Windowing and Background operation; in the Advanced section, set the values for Foreground and Background operations to be the same. Then click on the Lock Application Memory box, which keeps the application in memory while it is running, preventing 3.0 from swapping to disk. Finally, set up a folder in the Program Manager called File Utilities and install two icons with appropriate labels to call up the two .PIF files.

Now to format a low-density disk, all I have to do is click the appropriate icon. I never have to look at the DOS prompt!

Michael Ferrara
via CompuServe



Mr. Ferrara and I must have a different version of FORMAT. No matter what I entered in the .PIF file, I always got the same message from FORMAT: "Drive letter must be specified." FORMAT would then return an error message and quit. Clearly, the parameters I specified were never passed to the FORMAT program when the .PIF file was run. I did, however, make it work by introducing an intermediate batch file called WINFORM.BAT, which has one line:

```
FORMAT %1 %2.
```

In the .PIF file, I simply changed the program name from FORMAT.COM to WINFORM.BAT; the optional parameters remained the same as before. Now, with the batch file conveying the command line needed by FORMAT, everything worked just fine.

This workaround shows how *Windows* can be customized, especially in enhanced mode. It also shows that in that same mode, standard applications can multitask with *Windows* and with each other: simply select Background operation in the Execution section of the .PIF, and you can execute a program while using a *Windows* application.

For example, at work I set up a DOS shell for background operation that runs editing programs and a C compiler. While compilation executes in the background, I can perform other useful tasks (or, more realistically, play solitaire) in *Windows*. You can also switch to another standard application—and leave the first one run-

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Windows

ning—provided the foreground application is not set for Exclusive operation.

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TRACKING PRINTER DRIVERS

Does Microsoft (or any third party) have Windows 3.0 drivers that are compatible with my Quadram QuadJet Color Printer?

Bruce Martin
Cleveland, Ohio



Unfortunately Windows 3.0 does not include this ink jet printer on its hardware compatibility list, nor can I find any mention of it in the Windows setup data file SETUP.INF. Worse yet, Quadram itself reports that the QuadJet emulates an IDS Prism—a printer that is

**Certain drivers handle
more than one printer,
including, in some
cases, ones not listed
in Windows' Setup file.**

also not supported in Windows. For owners of QuadJets this news is pretty dim; however, there are other users of old or little-used printers who have found themselves in a similar situation. These users may find a solution.

You will not find a mention of Quad-

ram in Windows documentation; however, you will find a driver for the QuadJet in *Paintbrush*, Version 3.10, which runs under DOS. How can this help with Windows? Look through SETUP.INF in *Paintbrush*; listed there, you'll find more printers than printer drivers. Certain drivers handle more than one printer, including, in some cases, ones not listed in Setup. In such cases, the first step is to discover if your printer will emulate some well-known standard. Sometimes your printer's documentation can help in finding this information. If it does, try using the correct driver. If the manual does not have this information, contact the manufacturer. It may give you some good news. It didn't work in the QuadJet's case, but the investigation is still worth a try.

OPENING WINDOWS

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SHADOWED BOXES IN CLIPPER

Clipper's SAVESCREEN() and RESTSCREEN() functions can be used to produce shadowed boxes. SBOX, in Figure 1, draws a box using the parameters top row, left column, bottom row, right column in the color specified. It then "repaints" portions of the screen to create shadows beneath the box. You can then draw your data entry screens or menus inside the box.

The *Clipper* function SAVESCREEN() saves a portion of the screen into a memory variable. The memory variable contains all of the characters and their color attribute bytes for the saved area. By changing the background color of all the attribute bytes to black and then "dimming" the foreground before restoring with the RESTSCREEN() function, you produce the effect you want—shadowed boxes.

Virgelio V. Carpio
Makati, Metro-Manila
Philippines

 Since commercial programs such as *Microsoft Works* and *Microsoft C* are enhancing the user interface with shadows, users are coming to expect the feature in custom applications.

■ **SHADOWED BOXES IN CLIPPER:** A short routine lets you dress up your application the way commercial ones do.

■ **REPLACING FIELDS FROM ARRAY ELEMENTS:** A simple procedure gives you an alternative to coding REPLACE statements.

■ **DETERMINING THE LENGTHS OF CHARACTER FIELDS:** Save disk space—find out how long your text fields really must be.

There are two kinds of shadows: solid and transparent. Solid shadows replace the underlying characters with the shadow character, usually a solid block. Transparent shadows affect only the underlying character's attribute, darkening the character's appearance to simulate a shadow.

Several of the commercial *Clipper* libraries provide routines that set screen attributes or draw windows using shadows. dLesko Associates' *FUNcky Library*, for example, includes a box routine that supports both types of shadows. This routine lets you set the color of the shadow. (It's also written in assembler, so it's fast.) You should consider one of these libraries if flexibility and speed are paramount. But if you're doing without third-party support, Mr. Carpio's handy routine works well and uses only documented *Clipper* routines. The listing in Figure 1 includes the SBOX procedure and a sample program that illustrates its use. The output from the sample program appears in Figure 2.

The routine relies on the SAVE-SCREEN function storing the screen in its native format—sets of character/attribute pairs. Therefore, every second byte of the saved memory variable contains an attribute, ripe for replacement—an easy task using the STUFF function.

REPLACING FIELDS FROM ARRAY ELEMENTS

I was glad to see the addition of arrays to *dBASE IV*, Version 1.0. COPY TO ARRAY

SBOX

```
*
* TEST program for procedure sbox
*
SET COLOR TO w+/r
CLEAR
pcmag="PC Magazine PC Magazine PC Mag"+;
"azine PC Magazine PC Magazine "+;
"PC Magazine PC Mag"
single = CHR(218)+CHR(196)+CHR(191)+;
CHR(179)+CHR(217)+CHR(196)+CHR(192)+;
CHR(179)
@ 0,0,24,79 BOX single+"x"
i = 1
DO WHILE i <= 23
  @ i,1 SAY pcmag
  i = i + 1
ENDDO
DO sbox WITH 7,20,17,60,"w+/gr"
@ 12,27 SAY "Hello!"
@ 12,34 SAY "Can you see my shadow?"
INKEY(0)
RETURN
*
```

COMPLETE LISTING

```
* PROCEDURE sbox(x1, y1, x2, y2, clr)
*
* draw box with shadow
*
PROCEDURE sbox
PARAMETERS x1, y1, x2, y2, clr
PRIVATE v,h,i
v = SAVESCREEN(x1+1,y2+1,x2+1,y2+2)
h = SAVESCREEN(x2+1,y1+2,x2+1,y2+2)
FOR i = 2 TO LEN(h) STEP 2
  h = STUFF(h,i,1,CHR(7))
NEXT
FOR i = 2 TO LEN(v) STEP 2
  v = STUFF(v,i,1,CHR(7))
NEXT
SET COLOR TO &clr
@ x1,y1 CLEAR TO x2,y2
@ x1,y1 TO x2,y2
RESTSCREEN(x1+1,y2+1,x2+1,y2+2,v)
RESTSCREEN(x2+1,y1+2,x2+1,y2+2,h)
RETURN
```

AVAILABLE ON

PC
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%% save shaded
%% area
%% dim the
%% area with
%% color "w/n"
%% (chr(7))

%% draw box

%% draw its
%% shadow

Figure 1: Using *Clipper's* SAVESCREEN() AND RESTSCREEN() functions, this procedure draws the box shown in Figure 2.

Computers, FCC Class A, Class B, and You — or When is it better to get a B than an A?

You need to know the difference between computers that meet the FCC class B radio frequency emissions standards and those that meet only the Class A standards.

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Buyers seeking computers for use in homes (including offices at home) should shop for computers and peripherals which have been Class B certified. These devices carry a label with an FCC ID number. Both new and used Class A verified devices may be sold only for use in commercial and industrial locations. Signals from computers are more likely to be masked by electrical noise from other equipment in such an environment. These areas are also likely to have fewer radios and TVs. Accordingly, equipment marketed only for use in these locations may meet the less rigorous Class A standard. Class B certified equipment may be marketed for use in residences as well as commercial and industrial locations.

As you shop for a computer for use in your home, look for the FCC classification in the specifications or ask your vendor to recommend only machines that have been certified to the Class B limits. TV viewers and radio listeners in your home and in neighboring homes will be glad you did.

Databases



Figure 2: You don't need third-party library support to enhance your applications with shadow boxes. The shadow output here was produced by the SBOX procedure in Figure 1's sample Clipper program.

and APPEND FROM ARRAY make it easy to create an array from a record or append a new record from an array. However, there is still no command in Version 1.0 that replaces an existing record from an array. The following procedure, AREPL, simulates a REPLACE FROM ARRAY command:

```
PROCEDURE AREPL
PARAMETER arname
num = 1
DO WHILE LEN(FIELD(num)) > 0
    fname = FIELD(num)
    REPL &fname WITH &arname[num]
    num = num + 1
ENDDO
RETURN
```

Assuming that an array with the data to replace the current record exists, call the AREPL procedure with the name of the array in quotes. For example, if the array is named RDATA, then you would issue the following command:

```
"DO AREPL WITH 'RDATA' "
```

Denis J. Useo
Old Bridge, New Jersey



It is cumbersome to initialize memory variables with the contents of the current record and then code a series of REPLACE FROM statements. Arrays can make this a more palatable procedure, as long as your dBASE implementation provides the required dBASE commands.

FoxBASE+ and FoxPro users have long enjoyed the SCATTER and GATHER commands, which perform record-to-array and array-to-record operations. Particularly handy is that the arrays do not have to be created beforehand—these commands can create them for you automatically.

While dBASE IV, Version 1.0, includes the COPY TO ARRAY and APPEND FROM ARRAY commands, the missing REPLACE FROM ARRAY command will not appear until Version 1.1 is released.

In the meantime, if the task of coding REPLACE statements is getting you down, you can use the procedure listed above—as long as the record does not contain memo fields.

When dBASE IV processes the COPY TO ARRAY command, it creates a new array element for each field it encounters in the current record—except for memo fields. If, for example, the third field in your database structure is a memo field, dBASE IV will skip that field and go right on to the next when creating the array. This means that the third array element will actually contain the fourth field's data. If you then used the AREPL procedure, it would REPLACE the third field (the memo field) with the data in the third array element. Of course, this is really the data intended for the fourth field. So avoid using AREPL for databases that contain memo fields.

You should also keep in mind that the DO WHILE loop in AREPL is slower than sequentially processing a series of REPLACE FROM statements. The reason for

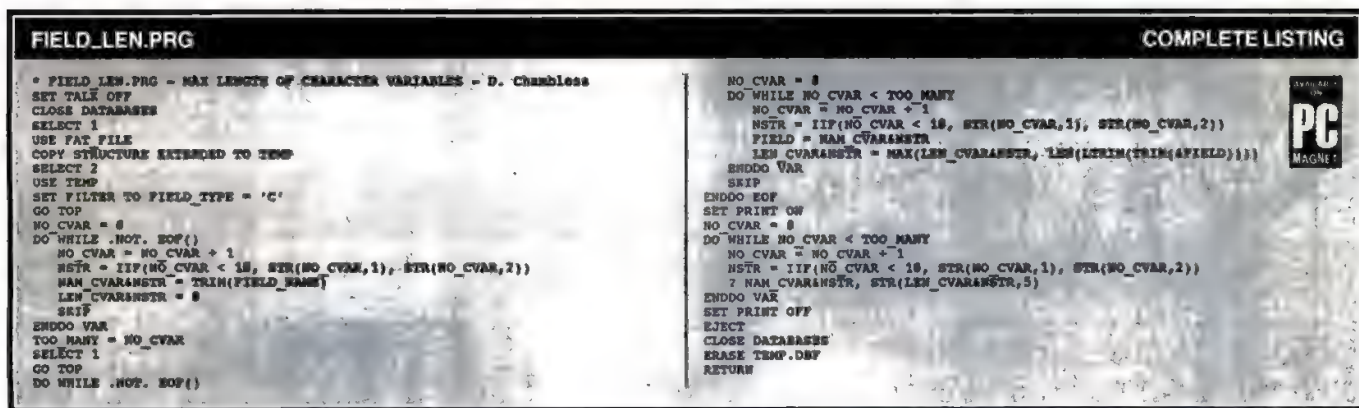


Figure 3: This program examines a .DBF file and reports the minimal field length you can use without losing any characters.

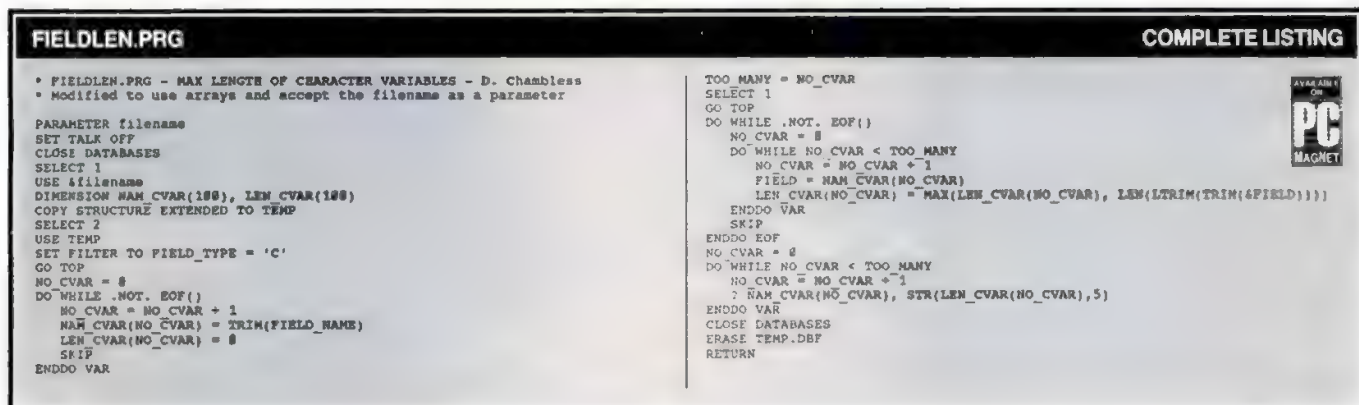


Figure 4: This is a modified version of the program shown in Figure 3. FoxBASE+ and FoxPro users may prefer this version, since it can use arrays and accept a filename as a parameter. It also executes slightly faster than the original version.

this is that *dBASE* must branch back to the beginning the loop for each REPLACE and then check when it would be appropriate to leave the loop. It executes the LEN(FIELD()) and FIELD() function once for each REPLACE, as well as performing macro expansion on the REPLACE statement and incrementing the num variable. Because it has this extra work to do, the AREPL procedure executes more slowly.

DETERMINING THE LENGTHS OF CHAR FIELDS

I frequently have to download data from minis or mainframes and import it into a database application on a PC. Not knowing the lengths of the fields that will be needed in the DBF file after the data is correctly imported is a regular nuisance; excessive field lengths can, of course, waste a great deal of disk space.

After putting it off for a long time, I finally sat down and developed a solution. The resulting program (shown in Figure 3) examines the character fields in a .DBF file and reports the minimal field lengths that can be used without losing any characters. (I write my applications in FoxBASE, but I have

avoided the use of arrays so that the program is compatible with *dBASE III Plus*. You can then use your judgment to adjust the character field lengths.

Donald A. Chambliss
Montgomery, Alabama

**This *dBASE* utility
examines the
character fields in a
.DBF file and reports
the minimal field
lengths needed.**

 What a useful utility! One of the disadvantages of the *dBASE* file format is its inability to allow for variable-length text fields. This can amount to a great deal of wasted space, es-

pecially if you've overestimated the size of your character fields. You can use this program to find out just how much of those character fields you really need.

Since Mr. Chambliss opted for *dBASE III Plus* compatibility, users of FoxBASE+ or FoxPro may prefer the program in Figure 4, which I modified to use arrays and accept a filename as a parameter. It executes slightly faster than the original version.

LET US HEAR FROM YOU

Share your database experience, tips, and techniques and we'll pay you \$50 for any submissions we print. Submissions must be made on-disk, and be sure to include a printout. Mail your contributions to Databases, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column for instructions.)

Research for this article was provided by Salvatore P. Ricciardi, a New York-based consultant and frequent contributor to *PC Magazine*.

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Spreadsheets

BROADEN THE CAPABILITIES OF FILE WORKSPACE SAVE

Quattro Pro doesn't offer a command to save all open worksheets at once, so I wrote the macro listed in Figure 1. The macro uses the /File Workspace Save command to create a workspace file. It then reads the file to find the number of worksheets in memory. Finally it uses a FOR loop to save each open worksheet.

Bob Duffett
Athens, Georgia



A command with a name like /File Workspace Save *sounds* like it ought to save all files in the workspace—in other words, all open worksheets. However, *Quattro Pro*'s /FWS does not do this. It simply creates a file that lists the name and screen position of each worksheet currently in memory.

The workspace file is a plain ASCII file with the extension .WSP. Here's how it might look if you had five open worksheets:

Workspace

```
C:\QPRO\NORTH.WQ1 # 2 76 16 W
C:\QPRO\SOUTH.WQ1 # 8 76 22 W
C:\QPRO\EAST.WQ1 # 6 75 28 W
C:\QPRO\WEST.WQ1 # 4 76 18 W
C:\QPRO\CONSOL.WQ1 # 2 76 16 W
```

The first line consists of the word "Workspace". The remaining lines each list the full path and filename of a worksheet, four numbers that indicate the worksheet's screen position, and the letter W or Z—Z if the worksheet is in a zoomed window, W if it's not.

The /File Workspace Save command is a convenience because it allows you to re-assemble a specific constellation of spreadsheets at a subsequent working session. To do this, you just select /File Worksheet Restore and name the workspace file you saved earlier. *Quattro Pro* reads the workspace file, loads each worksheet into memory, and sets up your screen so that the arrangement of worksheets du-

■ **BROADEN THE CAPABILITIES OF FILE WORKSPACE SAVE:** All you need is a macro to turn this *Quattro Pro* command into a multifile save facility.

■ **DAY OF THE WEEK IN LOTUS 1-2-3:** Several Lotus functions let you build short formulas that insert day names into dates.

plicates the selected workspace.

But /File Workspace Save is no substitute for /File Save. You still have to save each worksheet file individually—a number of files that could add up to 32 (31 if you keep a File Manager window open). (Contrast this with *Microsoft Excel*, which has a File Save Workspace command. When you use this command in *Excel*, you're prompted to save any worksheets that have been changed since they were last saved.)

If you're using a lot of worksheets at once, you might want to take advantage of Mr. Duffett's save-all macro—particularly if you live in an area subject to power interruptions. (You can also rely on *Quattro Pro*'s Transcript facility as disaster insurance. Transcript records every move you make in a keystroke log file, which the program writes to disk periodically. If the lights go out, you can use Transcript to rebuild your worksheets.)

The macro begins by saving a workspace file. Then it opens that file and uses the {readln} command to count the number of worksheet files listed. When it gets to the end of the workspace file, it issues a {close} command and passes control to a file-save routine. The latter moves from window to window, saving each worksheet under its current name and stopping when all the files have been saved. For this to work, all open worksheets must have been saved at least once already.

The {close} command that begins the macro is included for good housekeeping. If the macro happened to be interrupted by Ctrl-Break during its most recent run, the workspace file might be left in an open state. If you then experienced a power interruption, you would probably lose the file. This wouldn't be tragic, since the

SAVING WORKSPACE FILES

COMPLETE LISTING

```
1      A      B
2      \S      {close}
3              (/ System;SaveWorkspace)CHKPOINT~r{esc}
4              {open "CHKPOINT.WSP",r}
5              {for COUNTER1,1,32,1,RTN_READLN}
6              {close}
7              {for COUNTER2,1,COUNTER1-2,1,RTN_SAVE}
8
9      RTN_READLN      {readln TEXT}{forbreak}
10
11
12      RTN_SAVE      (/ File;SaveNow)r
13                  {nextwin}
14
15      COUNTER1
16      COUNTER2
17      TEXT
```

Figure 1: This macro saves not only a workspace file but all the worksheets in the workspace as well.

Spreadsheets

worksheets themselves would still be intact (in the versions most recently saved), but the {close} command costs nothing and is considered good form.

The second line of the macro saves a workspace file named CHKPOINT.WSP. The third line opens this file in read-only mode, and the fourth line sets up a FOR loop to count the number of lines in the workspace file.

**@CHOOSE,
@VLOOKUP, and
@HLOOKUP provide
efficient ways to turn a
serial date value into a
text string.**

The FOR loop is designed for 32 iterations, because—as already noted—*Quattro Pro* permits a maximum of 32 open worksheet files. If you have fewer than 32 files, RTN_READLN (the routine invoked by the FOR loop) will terminate the loop before all 32 iterations have taken place.

If you haven't worked with *Quattro Pro*'s (or 1-2-3's) file-handling macro commands before, the single line of the RTN_READLN routine may look a little strange. All the file-handling commands ({open}, {close}, {read}, {readln}, {write}, {writeln}, {getpos}, {setpos}, and {filesize}) have this property in common: If the command is carried out successfully, the macro ignores any subsequent commands on the same line. If the command fails, the macro reads and executes the next command on the line.

Thus, the {forbreak} command in RTN_READLN is executed only when the {readln} command that precedes it fails—in other words, only when all the lines of CHKPOINT.WSP have been read. In the meantime, our loop counter variable, COUNTER1, will have been incremented once for each pass through the loop. When you're through with the

RTN_READLN, the value attained by COUNTER1 will tell you how many files you have to save.

When the macro runs out of lines in the workspace file, the {forbreak} command terminates the FOR loop, returning control to the main body of the macro. The macro then closes CHKPOINT.WSP and initiates a second FOR loop. The second loop invokes RTN_SAVE, our file-saving, window-hopping routine.

The RTN_SAVE routine goes through COUNTER1-2 iterations, saving the current file and moving to the next window on each iteration. Why COUNTER1-2? Because COUNTER1 was incremented once for each file listed in CHKPOINT.WSP, once for CHKPOINT's "header" (the word "workspace" in the first line of the file), and once on the macro's final pass through the loop (when there were no more filenames to be read).

If you have a File Manager window open when you use the /FWS command, the workspace file creates an entry for that window—without a filename. If you have a File Manager window open when you press Alt-S, then Mr. Duffett's macro will attempt to save it along with all your open worksheets. The attempt will fail, but execution of the macro will continue and no harm will be done.

DAY OF THE WEEK IN LOTUS 1-2-3

Often, when working with dates, I need to know which day of the week a particular date falls on. Since *Lotus 1-2-3* has no @WEEKDAY function, I wrote the following formula

```
@IF(@MOD(A1,7)=1,"SUN",
@IF(@MOD(A1,7)=2,"MON",
@IF(@MOD(A1,7)=3,"TUE",
@IF(@MOD(A1,7)=4,"WED",
@IF(@MOD(A1,7)=5,"THU",
@IF(@MOD(A1,7)=6,"FRI","SAT")))))
```

I keep this formula in a library file so that I am able to copy it into my worksheets whenever I need it.

The date, represented by A1 in the formula, must be a serial date value and an integer. If the date has any fractional component, the formula returns SAT, regardless of the value to the left of the decimal point. Therefore, to get the current day of the week, I use @INT(@NOW) instead of just @NOW.

Michael Hoffman
West St. Paul, Minnesota



Using a set of nested @IF functions is one way to turn a serial date value into a text string. However, three other functions—@CHOOSE, @VLOOKUP, and @HLOOKUP—let you get the job done more efficiently. With @CHOOSE, you can rephrase the original formula as

```
@CHOOSE(@MOD(A1,7),"SUN","MON",
"TUE","WED","THU","FRI")
```

You'll find that this formula is easier to enter, easier to read, and easier to modify. Moreover, it does not require A1 to be an integer. In evaluating this formula, 1-2-3 disregards any fractional component of A1, so you are able to use @NOW without @INT and still get the correct day of the week.

However, the @IF and @CHOOSE approaches share a major shortcoming: the names of the days of the week are entombed in the formula itself. Why not put those names out on the worksheet where they can be referenced by many formulas, not just one?

Figure 2 shows how you can do that, using the @VLOOKUP function. The formula at B2 is

```
@VLOOKUP(@MOD(B1,7), $DAYTABLE, 1)
```

LOOKUP THE DAY			COMPLETE LISTING	
	A	B	C	D
1	Date:	12/31/99		
2	Weekday:	FRI		
3				
4		0 SAT	Sat	SATURDAY
5		1 SUN	Sun	SUNDAY
6		2 MON	Mon	MONDAY
7		3 TUE	Tue	TUESDAY
8		4 WED	Wed	WEDNESDAY
9		5 THU	Thu	THURSDAY
10		6 FRI	Fri	FRIDAY

Figure 2: This figure shows a lookup table that will return the name of the day of the week for any date entered at B1 on the worksheet. This is accomplished using the @VLOOKUP function.



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Spreadsheets

B1 contains the date whose weekday name we are looking for, and DAYTABLE is a name that is assigned to the range A4..E10. @MOD(B1,7) returns a value from 0 to 6. The @VLOOKUP function returns the text in the cell one column to the right of the number returned by @MOD(B1,7). For the date December 31, 1999, the @MOD portion of the formula returns 6, and then the formula as a whole gives us "FRI".

You should note that the reference to DAYTABLE is absolute. This allows you to copy the formula to another location on the worksheet and saves you the inconvenience of having to reenter the name of the lookup table.

DAYTABLE lists the days of the week in four styles—two abbreviated and two spelled out. By changing the last argument

set up such a table. The name MONTHTABLE is assigned to the range A4..E15, and the formula at B2 reads:

```
@VLOOKUP(@MONTH(B1), $MONTHTABLE, 1)
```

By combining the two tables, using the @STRING, @DAY, and @YEAR functions, and concatenating a few spaces and punctuation symbols, you can generate a fully spelled-out representation of any date, suitable for use in a formal report. For example, if B1 contained

```
@DATE(99,12,31)
```

then the formula

```
@VLOOKUP(@MOD(B1,7), $DAYTABLE, 4) & " " & @VLOOKUP(@MONTH(B1), $MONTHTABLE, 4) & " " & @STRING(@DAY(B1), 0) & ", " & @STRING(1999 + @YEAR(B1), 0)
```

LOOKUP THE MONTH					COMPLETE LISTING
	A	B	C	D	E
1	Date:	12/31/99			
2	Month:	DEC			
3					
4		1 JAN	Jan	JANUARY	January
5		2 FEB	Feb	FEBRUARY	February
6		3 MAR	Mar	MARCH	March
7		4 APR	Apr	APRIL	April
8		5 MAY	May	MAY	May
9		6 JUN	Jun	JUNE	June
10		7 JUL	Jul	JULY	July
11		8 AUG	Aug	AUGUST	August
12		9 SEP	Sep	SEPTEMBER	September
13		10 OCT	Oct	OCTOBER	October
14		11 NOV	Nov	NOVEMBER	November
15		12 DEC	Dec	DECEMBER	December

Figure 3: This figure shows another lookup table which functions in the same way as the one shown in Figure 2. This particular table is used in combination with the @MONTH function and will return the name of the month for any day entered on the worksheet.

in the @VLOOKUP function, you can select whatever style suits you best. For example, if you want to generate a day name spelled out with an initial cap, you would have to change the last argument in the formula from 1 to 4.

If you prefer a horizontal layout, you can use the @HLOOKUP function in place of @VLOOKUP. In order, to do that, you would put the numbers 0 through 7 in one row and the days of the week in one or more rows beneath the numbers 0 through 7.

You can also use a lookup table, in conjunction with the @MONTH function, to return the name of the month for any date you enter. Figure 3 shows how you could

would return "Friday, December 31, 1999." You might want to simplify this formula. To do this you can break out its components ("Friday," "December," 31, and 99) into separate cells and then reference those cells.

HINTS, TIPS, QUESTIONS

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by
Craig L. Stark

The Working Word

WORDPERFECT HOTKEYS AND TSRs

WordPerfect's advanced macro programming language provides powerful capabilities for formatting custom on-screen messages. To implement these formats, you must use a variety of control-key combinations: Ctrl-L clears the screen, Ctrl-P positions the cursor, Ctrl-J turns on bold, Ctrl-N Ctrl-P creates a blinking display, and so on.

Many of these key combinations have already been assigned to other functions. But *WordPerfect* provides a protective workaround for its own keyboard definitions: Hitting Ctrl-6 replaces any keyboard reassignments made in Setup with the original keyboard layout; and once in the macro editor, you can type Ctrl-V to bypass *WordPerfect's* other keyboard assignments.

While this takes care of conflicts within the application, hotkeys used by memory-resident (TSR) utility programs can cause trouble. However, I have a solution that lets you work on your macros without having to remove the TSRs from memory. Rather than typing, for example, Ctrl-P, try typing Shift-Ctrl-P. In scanning for keyboard input that matches its hotkey, the TSR will usually consider *both* the Shift and the Ctrl significant. *WordPerfect*, on the other hand, ignores the Shift when Ctrl is also typed. The result is that I can now enter a Ctrl-P in my macro without popping up my TSR printer utility!

Even Metcalf
Denver, Colorado

 Since conflicts are so frequent, many TSR programs try to provide alternative hotkeys, but many old ones do not. This tip will work with some memory-resident utilities and not with others. So I have some alternative solutions that you can try.

First of all, there are probably only a couple of key combinations on any given system that will conflict. It's easy enough to disable the problem TSR and create an Alt-key macro that will insert the particular keystroke. The only hitch is that you must

■ **WORDPERFECT HOTKEYS AND TSRs:** A simple trick helps you avoid conflicts with many TSRs.

■ **UPPER-ORDER ASCII IN WORD:** Consult an Extended Character set ASCII table from within your document.

■ **DUPLICATING TABLES IN WORDPERFECT:** Copying table templates can be done even with the delete/undelete method.

remember to use the macro key instead of the conflicting key combination.

You can also use the Alt-Z macro, shown in Figure 1. Simply execute this macro and whatever letter you type next is converted into the corresponding control character. So if you press Alt-Z and then a P, the P is automatically entered as Ctrl-P.

The logic of the macro is quite simple: First it tests for the pressed key's case. If

the key is neither upper- nor lowercase (meaning it is not a letter), the macro quits. If the letter is a capital, the macro converts it to its ASCII number, subtracts 64, and then converts it back to a character. If the letter is lowercase, the macro processes it in the same way, this time subtracting 96. Either way, the result is the character's control equivalent.

UPPER-ORDER ASCII IN WORD

Microsoft Word processing jobs often require unusual characters, such as Greek or foreign-accented letters. Many printers will generate these characters from the IBM extended or high-bit character set, and *Word* (as well as many other word processors) offers an easy way to access them: just press Alt with the decimal equivalent of the character on the numeric keypad. Thus, to enter a sigma (Σ), you'd simply press Alt-228.

Software manuals and reference books carry charts listing the characters and their decimal (and even hexadecimal) equivalents. But it isn't always practical (or possible) to keep these manuals and books on hand. Instead, you can create your own high-bit character chart and store it as a *Word* file. One such chart is shown in Figure 2. To determine the correct ASCII code, find the character you need and add the

ALT.Z.WPM

COMPLETE LISTING



```
{CHAR}1""
{IF}"{VAR 1}">"@&"{VAR 1}"<["{GO}caps"(END IF)
{IF}"{VAR 1}
">"@&"{VAR 1}"<["{GO}smalla"(END IF)
{QUIT}
{LABEL}caps"
{ASSIGN}
2"{VAR 1}"-64"
{GO}continue"
{LABEL}smalla"
{ASSIGN}2"{VAR 1}"-96"
{LABEL}
continue"
{ASSIGN}1"{VAR 2}"
{VAR 1}

*** end of macro ***
```

Figure 1: Execute this *WordPerfect* macro and any letter you next press will be converted to its control-character equivalent. Use the macro when macro hotkeys interfere with those of your TSRs.

The Working Word

A SAMPLE HIGH-BIT CHARACTER CHART										COMPLETE LISTING											
HIGH BIT ASCII CHARACTERS																					
	0	1	2	3	4	5	6	7	8	9		0	1	2	3	4	5	6	7	8	9
110											120										
130	é	ä	û	ä	å	ç	è	é	ê	ÿ	140	í	ì	í	î	ï	ñ	ò	ó	ô	
150	õ	ö	ý	ö	ù	ú	û	ü	ý		160	ä	å	ä	å	ä	å	ä	å	ä	
170	¸	¸	¸	¸	¸	¸	¸	¸	¸		180	¸	¸	¸	¸	¸	¸	¸	¸	¸	
190	¸	¸	¸	¸	¸	¸	¸	¸	¸		200	¸	¸	¸	¸	¸	¸	¸	¸	¸	
210	¸	¸	¸	¸	¸	¸	¸	¸	¸		220	¸	¸	¸	¸	¸	¸	¸	¸	¸	
230	¸	¸	¸	¸	¸	¸	¸	¸	¸		240	¸	¸	¸	¸	¸	¸	¸	¸	¸	
250	¸	¸	¸	¸	¸	¸	¸	¸	¸												

Figure 2: Keep this chart (or one like it) in a *Microsoft Word* file and you can always find the correct ASCII code to enter for high-bit characters.

column and row labels. For example, Σ is in the row labeled 220 and the column labeled 8; 220 plus 8 equals 228.

When you need to refer to the chart, merge the file into your document (<esc> Transfer Merge *FILENAME.DOC*), and when you're finished, cancel the merge (<esc> Undo). The chart will disappear, leaving your document untouched.

David M. Johnson
Douglas, Arkansas

PC I share Mr. Johnson's need to consult an upper-order ASCII chart, as well as his penchant for mislaying the necessary reference books.

However, I can suggest a quicker solution than his Merge procedure. This is surely a case where you could take advantage of *Word*'s multiwindowing capabilities. Just load your ASCII chart into a second window and zoom it to full-screen size (Ctrl-F1). You can toggle between the document and reference chart by hitting F1. And if you prefer, you can always consult the Extended Character Set table in Appendix A of the *Reference to Microsoft Word*.

DUPLICATING TABLES IN WORDPERFECT

Here's a common trick for copying *WordPerfect* codes (or text). Delete and then undelete the code without moving the cursor. Except where start/stop codes are involved, the text remains unchanged; the code—now stored in a temporary buffer—can be pasted or "undeleted" elsewhere in the document. This feature effectively duplicates a copy operation, but it often requires fewer keystrokes than the standard block-and-copy combination. I have used the shortcut to copy every *WordPerfect*

code I can think of except one: a Table Definition code.

Having created a table and filled it with text, I wanted to make another table just like it—with different text. So I tried to copy the Table Definition code, [Tbl Def . . .], using the delete/undelete method. I was horrified, however, to find that the instant I deleted a

If you happen to delete
a *WordPerfect* Table
Definition code in a
saved document, you
can rectify the damage.

Table Definition code, all of the Cell codes associated with the table turned into Tab codes! An attempt to undelete the Table Definition code proved fruitless—it was as if the code had never existed. The contents of the table were still there, but I couldn't find a way to retrieve the actual table, even after I redefined it.

Moreover, blocking and then copying a table code won't work, either. When you reach the destination of the copy and hit Enter, nothing happens. You can block and copy an entire table from [Tbl Def . . .] to [Tbl Off]; however, this method transfers the contents as well. There seems to be no way to copy just the "shell" of the table.

Maybe this warning will save others from having to reconstruct their own tables!

A. J. Fried
Highland Park, New Jersey



The *WordPerfect Workbook* is the last place a power user would ever look to find a warning such as Mr. Fried's. But lo! Chapter 34 (Tables, Part I), page 429, of this tutorial guide presents the message loud and clear: "If you delete the Table Definition code, then *WordPerfect* places tabs between the columns using the current tab settings . . . You cannot undelete (F1) a Table Definition code unless you deleted both the table and the Table Definition code at the same time."

First of all, if you happen to delete a Table Definition code in a saved document, you can rectify the damage. Simply flip to the other window, load the file from disk, and copy it over.

Beyond this, there are a couple of ways you can work around the existing limitations. Press Alt-F3 to Reveal Codes. Then block the table—empty or full—delete that block, press F1 and then 1 to restore the block in the original location. You can then Restore it again as many times as you like throughout the document.

If your table "shell" contains only the number of rows and columns, this procedure saves relatively few keystrokes, and you could just as easily create new tables. On the other hand, if you need multiple copies of a much-formatted table—lots of bold or italic typefaces, decimal alignments, centered titles, and the like—it may be worth your time to create a dummy table using, say, single-character "data" entries. You can then delete these characters manually with a keystroke while Reveal Codes is on. The dummy data, sandwiched between the [Cell] codes, takes practically no time to chop out and leaves all formatting in place. You could also activate macro recording while you create the table and play back the keystrokes.

You would then, block *that* formatted but dataless table, delete it, restore it, and as before, restore it again wherever you like. When you enter your new data into each of these shells, it will follow the formatting that you have incorporated.

TIPS FROM WORKING WORDSMITHS

Tell fellow users about your latest word processing tips; we'll pay you \$50 for any tips we print. Please send your letter on a disk along with a printout. Mail your contributions to The Working Word, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column).

by
Neil J. Rubenking

User-to-User

SEARCH AND REPLACE

Unix users frequently complain about the lack of a SED-like stream editor under DOS—and with good reason. SED gives you the ability to perform editor operations on entire groups of files, without human intervention. There are various ports of SED floating around bulletin boards, but I've found a substitute that's present on nearly every PC—EDLIN! EDLIN gives you the ability to perform some repetitive operations entirely in batch mode using scripts and redirection. Because EDLIN is present on almost every PC, widely distributed batch files can take advantage of it.

Here's an EDLIN script called REPL2 to replace all occurrences of the string "DOG" with "CAT"

```
RDOG^ZCAT
E
```

Pull out your EDLIN manual—you'll find that the first line replaces all occurrences of DOG with CAT and the second line writes the file and exits. If you have multiple changes to make, just add more R (Replace) commands, each on its own line.

The FOR command processes multiple files, so the line below will perform the operations in the script REPL2 on all files that match any of the file specifications:

```
FOR %I IN (OM*.C *.H) DO EDLIN
%I <REPL2
```

There are some problems you should watch for. If your script is wrong, you can damage your files much more quickly than you can by hand, and interrupting such a script can be difficult. Solve this problem by testing the EDLIN script with just one file the first time around.

Clayton E. Cramer
Rohnert Park, California



EDLIN is certainly not a replacement for SED, but using the idea explained above, you can create a batch file (see Figure 1) that will replace

■ **SEARCH AND REPLACE:** Use an EDLIN script to search and replace words in a group of files.

■ **COPY COMMAND QUIRKS:** The COPY command has some hidden features, which snag you sometimes.

any single word with another single word in a group of files. REPL.BAT takes from three to nine parameters. The first parameter is the word to search for and the second is the word with which to replace it. The remaining parameters (there may be up to seven) are file specifications, for example *.PAS *.INC *.ASM.

It is not possible to embed a ^Z (Ctrl-Z) in a batch file; therefore we decided to use DEBUG to create the script for EDLIN. When the DEBUG script is run, it creates a second script that instructs EDLIN to perform the necessary replacement. Notice the 1 before the R in the first line—without this, the script won't make replacements in

the first line of each file.

There are several limits to the power of REPL.BAT:

- It can work only on files that have a carriage return at least every 253 bytes (an EDLIN requirement).
- The search and replace strings cannot contain any spaces or other delimiters.
- The replace string cannot contain the search string—I'll explain the reason for this below.
- If any of the files are too big to fit completely in memory, EDLIN will only perform the replacement on the portion that does fit.

One suitable use for REPL is changing variable names in a set of program source files. Such files almost always have carriage returns at least every 80 characters, and individual program modules tend to be small enough to fit in memory.

Why the peculiar requirement that the replace string *not* contain the search string? You'll find that REPL.BAT processes some files more than once. The FOR command runs EDLIN on each matching file, and EDLIN saves the edited version as a new file, renaming the old file with a .BAK extension. The FOR command may treat the edited file as another matching

REPL.BAT

1 of 2

```
@ECHO OFF
IF '%3'=='' GOTO explain
ECHO Now checking for valid parameters . . .
ECHO %2 | FIND "%1" > XXXXXXXX.TMP
REM Only if %2 contained %1 will the tempfile be
REM non-empty. DOS won't copy an empty file. So
REM if the second tempfile exists, %2 DID contain %1.
COPY XXXXXXXX.TMP YYYYYYYY.TMP > NUL
DEL XXXXXXXX.TMP > NUL
IF EXIST YYYYYYYY.TMP GOTO BadParams
ECHO Replacing "%1" with "%2" in files matching:
ECHO %3 %4 %5 %6 %7 %8 %9
:-----
ECHO Now creating DEBUG script. . .
ECHO NTEMPDLN.SCR > TEMPDEBG.SCR
ECHO E CS:100 '1r%1' 1A '%2' 0D 0A 'X' 0D 0A 1A >> TEMPDEBG.SCR
ECHO RCX >> TEMPDEBG.SCR
ECHO 40 >> TEMPDEBG.SCR
ECHO W >> TEMPDEBG.SCR
ECHO Q >> TEMPDEBG.SCR
```



Figure 1: This batch file replaces one word with another in several files at once.

User-to-User

```
REPL.BAT 2 of 2
:-----
ECHO Now creating EDLIN script . . .
DEBUG < TEMPDEBG.SCR > NUL
DEL TEMPDEBG.SCR
ECHO Replacing "%1" with "%2" in files matching: > REPL.LOG
ECHO %3 %4 %5 %6 %7 %8 %9 >> REPL.LOG
:-----
ECHO Now performing replacement . . .
FOR %%f IN (%3 %4 %5 %6 %7 %8 %9) DO EDLIN %%f < tempedln.scr >> REPL.LOG
DEL TEMPEDLN.SCR
ECHO To see a log of the work REPL.BAT did, read the file REPL.LOG
GOTO end
:BadParams
DEL YYYYYYYY.TMP > NUL
ECHO Unfortunately, the string "%2" contains
ECHO the string "%1". REPL.BAT can't handle that.
GOTO end
:Explain
ECHO SYNTAX: "REPLACE findstr replacestr filespec [filespec...]"
ECHO This batch program will search files matching up to 7
ECHO file specifications and replace all occurrences of the
ECHO "find string" with the "replace string" in each file.
:end
```

file. Now picture this—the first pass replaces “agree” with “disagree”. The second pass replaces “disagree” with “dis-disagree”. To avoid this sort of problem, REPL.BAT refuses to accept a replace string that contains the search string. If you really wanted to replace “agree” with “disagree”, you could use an intermediate unique word. Replace “agree” with “ZYXQK” in one pass, and replace “ZYXQK” with “disagree” on a second pass.

COPY COMMAND QUIRKS

Although I began computing with DOS 1.0 on my 64K IBM PC and now program both systems and applications, I recently discovered something *new* about DOS. I'm currently using DOS 3.3, but I believe it applies to all versions.

To save keystrokes when copying files, I sometimes use wildcards, even to copy a single file. For instance, to copy C:EQPTLST1.WR1 to drive A: I'd simply enter COPY E*.* A:, if no other files in the current directory began with E.

But recently I noticed a copy that was smaller than the original copy. Using the full filename (COPY EQPTLST1.WR1 A:LIST1.WR1) produced a correct copy, as did wildcard copying using the same name (COPY E*.* A:). However, COPY E*.* A:LIST1.WR1 failed!

I knew about the binary and ASCII flags in the COPY command. Since the file was a spreadsheet, and thus binary, I immediately suspected the copy was done in ASCII mode. But how could that be the case? The

DOS manual clearly states that COPY defaults to /B, (binary copy based on directory size) when files are not being concatenated, and /A (ASCII copy, which ends at the first Ctrl-Z character in the file) when they are. I wasn't concatenating files, so what happened?

COPY assumes that a wildcard in the source filename means you want to copy more than one file. When you enter a target filename, DOS thinks you want to concatenate all matching files.

COPY assumes that a wildcard in the source filename means you want to copy more than one file. When you enter a target filename, DOS believes you want to concatenate all matching files into a new one. It therefore defaults to /A. If your file contains a Ctrl-Z character, anything after that character gets cut off.

If you want the copied file to have a different name from the original, you have two choices. You can avoid wildcards by typing the full name of the source file (COPY EQPTLST1.WR1 A:LIST1.WR1), or you can use the /B switch (COPY /B E*.* A:LIST1.WR1).

David Beckwitt
Anchorage, Alaska



The DOS COPY command has some surprising twists. The ASCII and binary switches apply both to the source files and the target. An /A after a source file tells DOS to copy that file only up to the first ^Z character. A /B after a source file tells DOS to copy the entire file. Either switch affects all the source files that follow, until another /A or /B switch supersedes it.

If you list several source files and separate them with a plus sign and you don't specify a target file, DOS will append them all to the *first* file specified. It is also possible for you to append *no file* to the first file with the command COPY filename+,,. Notice that there's nothing between the commas, so this command simply copies the file to itself. Useless? Not at all.

An /A switch after the target file tells DOS to end the file with a ^Z character, and a /B switch tells it *not* to. If you copy an ASCII text file to itself with the /B switch, it removes any number of ^Z characters from the end of the file (as well any text that follows the ^Z). Copy it with the /A switch and it adds a final ^Z if one isn't already there. The commands are COPY filename+,,/B to strip final ^Z's and COPY filename+,,/A to put back a ^Z. Never use these commands on a binary file—they'll truncate the file at the first ^Z byte.

As a side effect, copying a file over itself sets the file's date and time to the current system date and time. With just a slightly different syntax, the COPY command can safely update the date/time stamp of any file. COPY /B filename+,, does the job.

SHARE YOUR SECRETS

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by
Jeff Prorise

Tutor

DOUBLE-SCAN CGA VERSUS EGA

What's the difference between double-scan CGA cards with resolutions of 640-by-400 pixels and EGAs with 640-by-350 resolutions? Since the double-scan CGA packs more pixels per screen, why can't it run EGA software?

Dave Kelly
Christchurch, New Zealand



Double-scan CGA cards have the same addressable array of 640 by 200 pixels as conventional CGA cards, but they use a technique known as scan doubling to simulate a 640-by-400 screen. Scan doublers double the *apparent* resolution of the screen by replicating each row of pixels and inserting the identical row one scan line lower. But while the screen may appear sharper, the resolution is still only 640 by 200 dots per inch. The pixels that make up the extra 200 lines aren't addressable through software as the pixels on a 640-by-350 EGA screen are.

Figure 1 shows a side-by-side comparison of two images, one rendered on ten consecutive scan lines in a single-scan 640-by-350 graphics mode, the other in a double-scan 640-by-400 graphics mode. The single-scan adapter is able to form the character with more clarity because each pixel in the grid can be controlled individually. The same character on a double-scan adapter appears much coarser, because the pixels on every other line are hardware-generated clones of the ones above.

Why can't a CGA with a scan doubler run EGA software? Architectural differences between the two adapters—differences that run much deeper than screen resolution—prevent compatibility. For example, programs typically head straight for the adapters' control registers for fast video processing. The CGA adapter, based on Motorola's 6845 video controller chip, had 18 registers; the EGA has more than 50. Obviously, if a piece of software tries to write to one or more EGA registers that don't appear on the CGA, the process

■ **DOUBLE-SCAN CGA VERSUS EGA:** Though they display similar resolutions, these two video adapters are definitely not the same.

■ **FORMATTING DOUBLE-DENSITY DISKS TO 1.44MB:** While your drives may not stop you, loss of data may.

won't work—no matter what the resolution of the video card. And the inconsistent number of registers is only one difference.

Double-scan CGAs were an attractive alternative to higher-priced EGA video adapters five years ago. But EGA adapters now cost less than \$150 (and VGAs with 640-by-480 resolutions sell for not much more), so there's little reason not to have one. Your software will thank you for it.

FORMATTING DOUBLE-DENSITY DISKS TO 1.44MB

One question that has often come up in the Tips/Utilities forum on PC MagNet concerns the difference between double-density (DD) and high-density (HD) 3.5-inch disks. Many readers have found that 720K disks can be formatted to 1.44MB without apparent error, and so they wonder why there's such a difference in cost. Can DD disks be safely used as HD disks? If so, is the cost difference justifiable? Why buy the more expensive HD models?

The answer to the first question is yes, there is a difference. Disks aren't like CPU chips, which are sorted into those that will run at 16 MHz but not 20, 20 MHz but not 25, 25 MHz but not 33, and so on. The difference between disks lies not in their structures but in their coatings. HD disks have higher-quality, finer-grained coatings, which permit the flux transitions that represent binary 1s and 0s on the surface of a disk to be packed closer together. The resulting disk supports higher data densities and the ability to handle 1.44MB formats

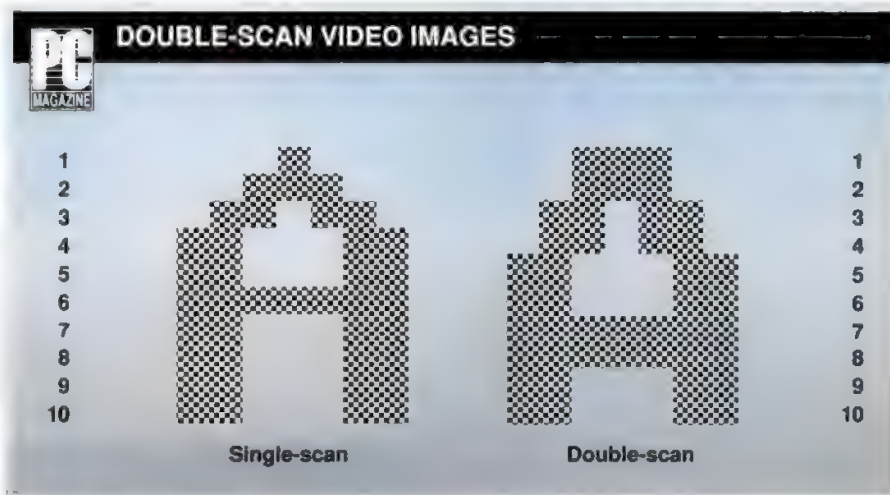


Figure 1: Double-scan video adapters double the *apparent* resolution of the screen by replicating each row of pixels one scan line lower. Here, the letter "A" is shown as it might appear in double and single-scan modes. Single scanning produces a smoother character because all of the pixels that make up the character are individually addressable. The double-scan image requires even-numbered rows to be identical to odd-numbered rows.

Tutor

without violating the limits of the recording medium—that is, without exceeding the prescribed data density.

One factor that affects a disk's ability to support high data densities is surface coercivity. In physics, coercivity is defined as the magnitude of the opposing magnetic force required to remove the residual magnetism from a saturated magnetic material. In disks, coercivity is a measure of the magnetic field required to force a flux transition. The higher the coercivity, the greater the resistivity flux transitions have to forces imposed by neighboring flux transitions, and the closer together these flux transitions can be placed. (See Tutor, *PC Magazine*, October 31, 1990, for a discussion on flux transitions.)

The coercivity of a typical high-density 3.5-inch disk is 700 oersted (an oersted is a unit of magnetic intensity, named after 19th century physicist Hans Christian Oersted). That's enough to support 1.44MB



Figure 3: High-density 3.5-inch disks have an extra hole opposite the hole that houses the write-protect tab that identifies them as HD disks to drives that have special DD/HD detection hardware. Disks that do not have this hole should not be formatted to 1.44 MB.

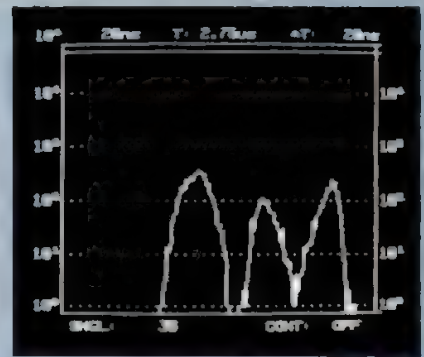
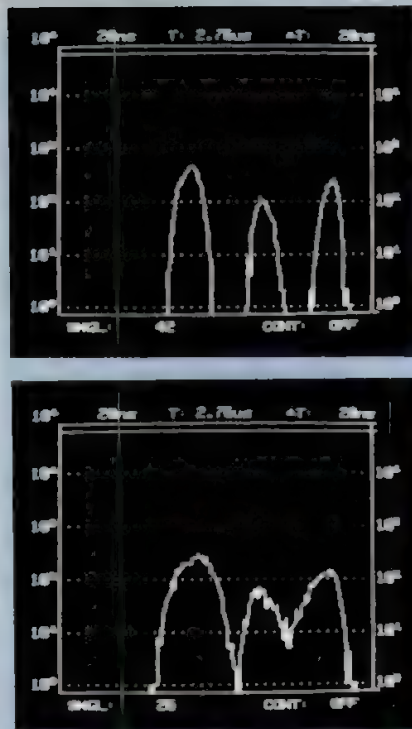


Figure 2: The results of time interval analysis tests performed on three disks: one HD and two DDs. All three have been formatted to 1.44 MB. Pulses representing flux transitions on the HD disk (top left) are distinct and evenly spaced. Pulses on the DD disk (top) are visibly less distinct. The DD disk (left) may produce read errors when it's read back because pulses recorded on its surface have run together to the point that it's difficult to distinguish between neighboring flux transitions. (Photos courtesy of Verbatim Corp.)

data densities with a comfortable factor of safety. However, the coercivity of a typical double-density 3.5-inch disk is only 600 oersted—adequate for 720K data densities, but marginal for 1.44 MB.

Because of this difference, 720K disks formatted to 1.44 MB are susceptible to *self-erasure*, a term that refers to the gradual disappearance of data written to disk. If the flux density exceeds what the coating can safely support, magnetized particles in the coating may interact with one another. Their interaction will cancel out existing flux transitions and create new ones where there were none before. Ones become 0s, 0s become 1s, and before long, data is irretrievably lost. Worse, the header information that precedes disk sectors may become scrambled, and so prevent any data from being lifted from affected sectors.

Tight tolerances on bit timings pose another problem when using DD disks in place of HD disks. A pulse will be read only within a narrow window of time when the drive is looking for it. Moreover, a drive expects pulses to be uniform and evenly spaced, like the ones shown in Figure 2A (top left). However, the higher head current used to write data to HD disks may saturate DD coatings and shift pulses until they fall outside the window. Bits that are moved outside may be lost. Conversely, pulses may occur when none are expected. Either way, the result is data error.

These photographs, taken from a device called a time interval analyzer, show the pulse patterns formed by flux transitions on three different disks. Figure 2A was produced on a HD disk, Figures 2B (right) and 2C (bottom left) on DD disks. All three were formatted to 1.44MB. Pulses on the DD disk in Figure 2B are visibly less distinct than those in Figure 2A. The DD disk in Figure 2C may produce read errors when it's read back: the pulses recorded on its surface have run together to the point where it's hard to distinguish between neighboring flux transitions.

The slight difference in coercivity also explains why most 720K disks *can* be successfully formatted to 1.44MB. The difference is less than you'd expect—after all, the difference in storage capacity is proportionally much greater—but it's enough to ensure a calculated risk when using DD disks in place of HD disks. Mark Rogers, Technical Services Manager for Verbatim Corporation, a leading disk manufacturer, estimates that the majority of DD disks formatted to 1.44MB will eventually exhibit symptoms of self-erasure, even if the initial format produced no errors. He likens this practice to playing Russian roulette with five chambers loaded. That's a bet not many would take.

It's interesting to note that the difference in coercivities between DD and HD 5.25-inch disks is much higher. A typical

Tutor

360K disk has a coercivity of about 300 oersted, while a 1.2MB disk averages about 600 oersted. Not surprisingly, 360K disks that can be formatted to 1.2MB without error are rare. Those that can probably won't retain data for any length of time.

You can tell the difference between 3.5-inch DD and HD disks by the presence of the high-density indicator hole opposite the hole that houses the write-protect switch, as shown in Figure 3. This hole permits drives equipped with inexpensive mechanical plungers or LED/photodiode optical sensors to differentiate between DD and HD media. Strangely, IBM elected not to build this hardware into its PS/2s. Thus in the absence of command-line switches, high-density PS/2 drives will willingly format 720K disks to 1.44MB.

Fortunately, many clonemakers include such hardware in their PCs, so the drive will prevent you from formatting a 720K disk to 1.44MB. Some users drill holes into DD disks so their drives think they're using genuine HD disks. This is a dangerous practice. At best, these disks are subject to coercivity problems identical to those encountered by all other DD disks. At worst, particles of plastic will find their way into the disk housing and damage the magnetic coating.

In the final analysis, the value of HD disks depends on the value of your data. The latest PC Connection ad offers 720K disks for \$15 and 1.44MB disks for \$29. The cost ratio is roughly 2:1—right in line with the 2:1 data storage ratio.

Even if you simply need a few throw-away floppies to transport data from one PC to another, you can't be sure that what you wrote to the DD disk will be what it reads back. The best advice: Don't play with fire. The extra money you pay will be worth the added peace of mind.

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. To have your questions answered, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). We're sorry, but we're unable to answer questions individually. ■

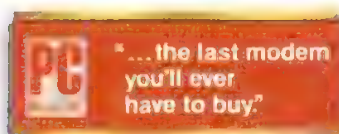
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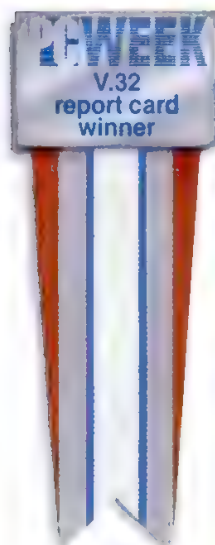
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CIRCLE 367 ON READER SERVICE CARD



by
Frank J. Derfler, Jr.

Connectivity

NETWORK FILE SHARING

I have a basic networking question. Suppose you call up the same file on networked computers A and B. You make changes on A and save them to disk. Computer B still has the old copy in memory, so when B saves to disk, you lose A's changes.

At least this happens to us when we use a program called *Timeslips III*. Am I missing a solution to this problem implemented by other programs?

James Simon

via PC MagNet on CompuServe



You're having this problem because the program you're using is not network aware. With the introduction of DOS 3.1 came the ability for application programs to open files for either shared or exclusive use. In concept, if an application opens a file for shared use, it will make changes by locking a range of bytes for exclusive use, modifying that range only, and avoiding massive reads and writes. When two applications attempt to work on the same range of bytes, DOS reports the conflict to the application for resolution. Your software apparently opens the file for nonexclusive use and then loads the whole file into memory.

You can use this nonnetworked software on the LAN (if you've got legal copies for each user), but you'll have to give each person his own subdirectory for data files, and you won't be able to share the same data files simultaneously. If you really need to provide multiple users with simultaneous access to the same data files, you'll need a networked database.

MODEM SHARING ON NETWORKS

We have a network running *NetWare* over Token-Ring wiring. How can we construct a setup that would allow multiple users to share a modem? What software and connections do we need? I assume we'll need a dedicated gateway with a modem attached?

John Stoltenberg
Chicago, Illinois

■ **NETWORK FILE SHARING:** If you need to share files, make sure your program is network aware.

■ **MODEM SHARING ON NETWORKS:** Here are some alternatives that may work for you.

■ **UNDERSTANDING OSF, DCE, AND SAA:** A plan for the future of networked computing.



Modem sharing over a network is becoming an increasingly smart thing to do. The cost of putting a modem on every desktop adds up quickly, and even the street prices for high-speed 9,600-bit-per-second modems with V.42bis data compression hover over \$800. So, it seems that the economics of sharing modems make sense.

Here are two quick points you should

Modem sharing over a network is becoming an increasingly smart thing to do.

note: First, modem sharing is typically a first-come-first-served proposition. This means that if a modem in the pool is available, you get it—otherwise your request for service is either denied or put into a queue. It doesn't have to work like this. There are ways to make a single call to CompuServe, for example, that will allow

each user to have his own CompuServe session from that one call using the X.PC protocol, but this solution is pretty complex for most installations.

Second, the solutions described here work primarily for outward-bound calls. These products won't allow someone to call in and use the network (the product for that is typically called a LAN Access Server), and it's tricky—though not impossible—to use them for incoming calls linked to your PC.

I need to provide a little history to help you understand why today's communications server systems work the way they do. MS-DOS has always contained a function call, interrupt 14, for communications services. However, for various reasons, including performance, the early developers of communications programs avoided using interrupt 14. They wrote their code so that it would directly address the communications hardware (the universal asynchronous receiver transmitter, or UART) in the PC. This method of addressing the UART family of chips in the PC hasn't changed as our systems have evolved from the 8008 to the 80486, and this is why communications software usually addresses the hardware directly.

Because the communications software circumvents DOS, the usual LAN redirector architecture doesn't work. DOS doesn't see the applications calls, so the redirector has nothing to redirect.

Companies tried to solve this problem using their own techniques, and consequently three different ways to share modems across a network were developed. The first method requires you to put a special piece of hardware (a card) in each workstation. This little card behaves like a COM port and interacts with the communications program. However, instead of moving data to and from an RS-232C cable, this hardware redirector moves data in and out of the network, to and from the PC that is acting as a modem communications server. J&L Products sells hardware redirectors for this purpose.

Connectivity

The second method lets you access DOS communications services using software with its own interrupt 14 drivers, such as Datastorm Technologies' *ProComm Plus*. When you select the interrupt 14 driver from the menu in *ProComm Plus*, the program routes its calls to DOS instead of sending them directly to the hardware. Then the LAN redirector software can capture the output and send it to the network communications server. In modern PCs, this combination performs well enough that it can be used even with 9,600-bit-per-second modems.

Finally, on Novell networks certain communications programs, including DCA's *Crosstalk Mk.4*, can take advantage of a special application interface that Novell provides to let the communications program skip around DOS and directly address the *NetWare* redirector in each workstation.

The bottom line on the workstation side is this: If you want to stick with the communications program you currently use and it doesn't have the special drivers needed to address DOS or *NetWare*, then you'll need to install hardware in each PC to redirect communications to the communications server. On the other hand, if you're willing to invest in the robust packages that provide these drivers, you'll have a relatively simple installation task, but you might face the task of retraining users on the new software.

Once you're able to route the data from the communications program in each PC to the network, you'll still need a communications server with modem-sharing software and multiple serial ports. Gateway Communications (800) 367-6555 sells an excellent asynchronous communications server package that includes the software needed to make modems available to the network clients as well as the hardware able to address multiple modems. You don't need a particularly powerful PC to act as a modem communications server in this configuration, but rather a machine dedicated to the job.

An interesting alternative to this comes from Fresh Technology. Its new product called *Modem Assist* lets any PC on the network make an attached modem available to other client PCs, even while the modem host runs other applications. To do this, you load specific *Modem Assist* TSR

modules in the client and server PCs. You still need software such as *Crosstalk Mk.4* or *ProComm Plus* in the client machines to address the *Modem Assist* software. We haven't seen this product in the PC LAN Labs yet, so I can't say what sharing a modem does to the performance of a foreground application running on the PC that's making a modem available, but with the right combination of CPU power and application software workload, this architecture should work well.

Modem Assist is available at \$495 for a package that supports up to five shared modems on a single network, and at \$995 for the 20-modem-per-network version. Call (602) 497-4200 for more information.

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three do together
is sure to make an
impact somewhere in
the market.**

UNDERSTANDING OSF, DCE, AND SAA

One of the folks in our company whose office is in the "glass house" mainframe computer room spoke up at a recent meeting and seemed to think it was important that, "OSF put together its DCE, and IBM will make it a part of SAA." What was he saying and why do we care?

Benjamin Runyan
New York, New York



Your denizen of the glass house might not express himself at a level everyone understands, but he is up to date on some interesting information. OSF stands for Open Software Foundation—a consortium founded by Hewlett-Packard, IBM, and Digital Equipment Corp. Anything these three do together is sure to make an impact somewhere in the

market. In this case, the Unix world is the target. In May of 1990, OSF announced the components of what it calls a Distributed Computing Environment or DCE. The goal of DCE is to allow users to run distributed processing applications across a network. This means that computers will share chunks of computing tasks as their workloads allow. With an increasing number of 80386-equipped PCs sitting on desktops wasting CPU cycles, the concept of dynamically allocating all the networked processing power appeals to certain folks. At the same time, the argument that some people simply don't like to share their personal desktop resources still carries weight.

While OSF focuses primarily on the Unix market, the DCE plan includes PCs running OS/2 and maybe even *Microsoft Windows*. Since many of us hold the perhaps unspoken belief that OS/2 will eventually rule corporate computing, this integration is important for future plans. Indeed, Microsoft's quick endorsement of the OSF plan, even though it doesn't belong to the consortium, was news enough to cause a large blip on the radar screens of many industry watchers.

A bigger return, however, resulted from the announcement that IBM will incorporate specific practices and protocols of DCE into its Systems Application Architecture (SAA). SAA has already had a huge impact on the entire computer software industry—DOS, OS/2, and Unix alike. The SAA documents describe how programs look on the screen, what the keystrokes do, and the underlying communications and data handling techniques involved.

So what's the bottom line? OSF's announcement of DCE and IBM's incorporation of DCE into SAA won't change the way you do your computing for two or three years at least, but you can expect that its impact on systems in five years time will be large.

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay \$50 for any tips we print. Please submit your letter on a disk along with a print-out. Then mail your contributions to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016, or you may contact Frank J. Derfler, Jr., via MCI Mail (be sure to use Derfler's box named PC MAGAZINE LAN LABS). We are unable to answer letters individually. ■

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VGA Wonder 256K/512K	\$245/299
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NEC

PC Magazine's Editors Choice

Graphics Engine 16 (1024x768)	\$679
Graphics Engine 256 (1024x768)	969

Paradise

VGA 1024 with 256K	235
VGA 1024 with 512K	265
8514/A Plus	569
VGA memory Upgrade	199

Video Seven

1024i VGA with 256K/512K	\$225/299
VRAM VGA with 512K	399

PC Brand Internal Modem
(100% Hayes Compatible)

\$49
1200BPS

\$75
2400BPS

Modems

ATI

2400ETC Internal with MNP5	\$159
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2400ETC External with MNP5	189
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Hayes

1200B Internal with Smartcom	\$189
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2400B Internal with Smartcom	259
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1200 External .. 285	2400 External .. 359
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PC Brand (100% Hayes Compatible)

1200 Internal with software	\$49
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1200 External .. 70	2400 External .. 129
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2400 Internal w/software/MNP5	75/129
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US Robotics

Courier HST 14,400 Int./Ext.	\$559/599
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Courier V.32 9600 External	675
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Courier Dual Standard External	995
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Fax Cards

Complete PC

Complete Fax 4800/9600	\$159/309
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Complete Communicator	419
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Complete Portable Fax 9600	309
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Hayes

4800/9600	\$199/495
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Intel

Connection Coprocessor	\$529
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Co-Processors

ITT

Complete Line	Call
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Intel

8087-1	\$189	8087-2	\$129
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80287-10	229	386SX-20	389
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80387-16	349	80387-20	399
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80387-25	479	80387-33	599
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Weitek

Abacus 20/25/33	Call
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VP150E 150MB External Novell certified ..	1175
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VP402 Interface Board for VP Series	115
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VP409 PS/2 Interface Board for VP Series	230
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VP60 Internal/External	639/795
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Mayntstream 60MB Portable	\$889
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Mayntstream 150MB Portable	1395
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Mayntstream 2200HS 2.2GB Portable	4350
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Colorado Memory Systems

DJ-10 Jumbo 40/80MB Internal	\$249
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KE-10 External Chassis Kit with Interface	139
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QFA500	Call
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CD-ROM

Microsoft

Bookshelf 1.0 \$195	Stat Pack	\$99
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Programmer's Library		295
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NEC

CDR82 Internal	\$654
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CDR72 External	729
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CDR35 Portable	439
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XT/AT Interface Kit	149
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Clipart 3D	285	Image Folio ..	285
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Sony Kits

CDU510 Int. ..	\$665	CDU1701 Ext.	\$779
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RAM/I/O and Accelerator Boards

Intel

Aboveboard Plus 512K	\$349
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Aboveboard Plus I/O	385
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Aboveboard Plus 8 2Mb I/O 2 Mb	529/615
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Inboard 386 PC with 1M	539
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Inboard 386 AT with 0K	859
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PC Brand I/O Cards

AT 1P/2S/1G	\$49
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XT 1P/1S/1G/Clock/Calendar	49
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Printers

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BJ130e 15"	\$695
LBP8-III Laser 8PPM	1650
Citizen	
GSX 140	\$295
GSX200	Call
Epson	
LX810	\$179
FX1050	\$315
LQ850	\$439
LQ950	\$479
LQ1010	\$405
LQ2550	\$899
EPL6000	\$849
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Deskjet Plus ..	\$710
LaserJet IIP ..	\$1025
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LaserJet IIP ..	2450

Laser Jet Accessories

Adobe (New!)	
HPLJII Postscript Cartridge	Call
Pacific Data Products	
Plotter in Cart. for II or IIP	\$249
25 in 1 Cart. for III or IIP	285
Postscript Cart. for III or IIP	375
1M Memory Card for IIP	269
CPI	
Superset+ 425 in 1	\$295
Jet Memory 1M for III or IIP	174
Postscript for IID, IIP, III	355
Princeton Publishing	
PS-388 Postscript board	\$2250

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for under \$2000

Networking Hardware

Gateway	
G/Ethernet AT\$435 for PS/2	\$435
G/Ethernet (8 bit)	265
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2 MBs Starter Kit/Adapter	\$409/195
Ethernet Starter Kit/Adapter	545/269
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PS110 Board for PS/2	\$395
PC500 16 Bit for WS/Server	260/335
PC550 16 Bit Tw. Pr. for WS/Server ..	291/355
PC270E Twisted Pair	139
PC130 Arcnet Board	117
ARCNET passive hubs/active hubs 72/321	
ARCNET intell. hub coax/Tw. pr. ..	495/609
Synoptics	
505UTP Transceiver	\$139
1000 Conc./2500 Workgroup Conc.	2575/839
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4 port hubs	\$49
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Lancard/A 16 bit ARCNET Board	249
Lancard/E 8 bit Ethernet	199
Lancard/E 16 bit ARCNET Twisted Pair ..	339
Lancard/E 8 bit Twisted Pair	329
Tops	
Repeater	\$135
Flashcard	\$155
Western Digital Ethercard+	
8 bit	\$185
Twisted Pair ..	\$319
PS/2	285
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16 bit	255
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Pocket ARCNET Adapter Coax or Tw. Pr.	\$295
Pocket Ethernet Adapter Twisted Pair	489

Novell Networking

(Novell Authorized Sales and Support)

4 User ELS Level I v. 2.12	\$519
8 User ELS Level II v. 2.15	1250
Advanced Netware v. 2.15	2150
SFT Netware 286	3350
SFT Netware 386	4550

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Brightwork Development	
PS-Print	\$279
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25 User	\$495
Expand	\$445
Remote	235
Gateway	895

Chayenna Software	
Netback	\$189
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De Vinci eMail Servers	
DOS	\$849
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Lanspace	\$310
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Customer 3.0 ..	\$135

Ontrack	
Disk Manager -N\$99	
Netutils	\$85
Tops	
NetPrint 2.0 ..	\$145
Network Bndl ..	\$169
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Desklink 2.2 ..	\$95
Laplink III	\$92

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Intelligent Serial Cards:	
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Epson LQ510

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Software

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Borland Quattro 95	329
Caere Omnipage 386 2.1	619
Datascram ProComm Plus	59
dBase IV	479
Microrim R-Base	489
Delrina Perform 2.0	159
Delta Technology Direct Access	59
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LC260	Call
LC290M	Call
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ML320	\$345
ML321	\$479
ML380	315
ML390+	475
ML391+	655
ML393+	995
Okilaser 400 4PPM	975
Panasonic	
1180	\$169
1191	\$235
1124	295
1624	369
1695	415
4420 Laser	885
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Smart Label	\$185
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Scanners/Digitizers

Complete PC	
Half Page Scanner	\$189
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Hand Scanner	165
Complete OCR Software for HS/Page ..	235/309
Kurta	
IS/One 12X12	\$399
IS/One 12X17	655
Microtek	
MSF 300G ..	\$1495
MSF 300Z	Call
MSF 400G/MSII ..	2750/1050
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12x12/12x18	\$335/599

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CalComp WIZ 1000 DPI	\$175
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Hi-Rez C9 Serial Mouse	\$79
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Trackman 320 DPI Serial/Bus	99/109
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Serial with Paintbrush 200 DPI	\$109
Serial with Windows 200 DPI	149
Bus Mouse with Paintbrush	105

Power Protection Products

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SK6 Spike Bar	\$29
CCI+ Isober	85
IB4 4 Outlet Isober	45
LC1200 Line Conditioner	169
BC325 Battery Back-up	245
BC450 Battery Back-up	297
OMNI 450LAN Battery Back-up	375
BC750LAN Battery Back-up	549
OMNI1200 Battery Back-up	795

Wyse Terminals	
WY60	\$309
WY150	\$305
WY370 14" Color	945
(Call for Keyboard options)	
WY50/WY85 (both w/Keyboard) ..	389/409
Santa Cruz Operations CompleteSys	
Xenix 286	\$995
Xenix 386	\$1150
Xenix Software	
Foxbase+ 386 \$779	
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Lotus 123 r. 3.0 409	
Microsoft Works99	
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Norton Utilities Advanced	95
Paradox v. 3.0 445	
PC Tools 6.0	95
Peachtree Acctg III w/Data Query ..	149/225
Pro. Write	145
QEMM 5.0	65
Quicken	39
Timeslips III	159
Symatec Q&A . 220	
Timeline 3.0	379
Timeworks Publish It!	115
Word Perfect 5.1	249
Wordstar 6.0	249
Ventura Publisher 2.0	519

Software for Windows 3.0 Environment

Aldus Pagemaker	\$499
AMI	129
AMI Pro.	319
Corel Draw v. 1.2	329
Microsoft Windows 3.0	99
Microsoft Excel 2.1	309
Microsoft Word for Windows	325
Precision Software Superbase 2	189
Precision Software Superbase 4	395
HDC Windows Express or Manager ..	49
Crosstalk for Windows 1.0	129

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Sony 3.5" 720K (box)	13
Sony 3.5" 1.44M (box)	25
5.25" Diskette Case	9
3.5" Diskette Case	11
Toner Cartridge for HP Deskjet Plus,	
LaserJet II and IIP	Call
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DC600(ea.) ..	\$27
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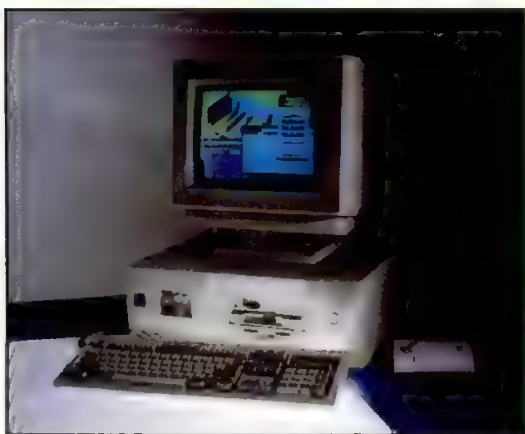
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FastData 386/SX

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Standard Features

- ✓ 16mhz Intel 80386-SX processor.
- ✓ 2 full megabytes of zero wait-state RAM.
- ✓ 40 mb 28ms IDE hard disk, 1:1 interleave, fast transfer rate.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive (2nd drive add \$79).
- ✓ Standard chassis with keylock, speed and reset buttons. (Optional chassis add \$50)
- ✓ 200 watt power supply
- ✓ Monochrome monitor with monochrome graphic board.
- ✓ Clock calendar, parallel port, and two serial ports.
- ✓ Keytronics 101 key enhanced keyboard.
- ✓ 8 expansion slots and 5 drive bays.
- ✓ Phoenix BIOS.
- ✓ Compatible with DOS, OS/2, Windows, Xenix and Novell.

Combine the benefits of an advanced Intel 386 processor, the value of a 286 and the advantages of FastData and you've got the FastData 386/SX! This machine is the choice of those who want to run today's powerful 386 and multitasking software, like Windows, and want to rip through their favorite programs, like Lotus and WordPerfect at blinding speeds. This machine is ideal to run the latest memory demanding and graphic software, right out of the box. We've made our customers' favorite options standard: it comes with an ample two megabytes of memory, a high performance 40mb hard drive, and 16 bit color VGA. Compare performance, features, and service and you will find no better SX value. Interested further? Try the FastData 386/SX for 30 days; you have to be happy - if not, we'll take it back.

System Price	40mb	65mb	80mb	100mb
Monochrome	\$1,299	\$1,399	\$1,519	\$1,699
VGA Color	\$1,599	\$1,699	\$1,819	\$1,999
VGA 1024	\$1,749	\$1,849	\$1,969	\$2,149



FastData 386/25

\$2299

Standard Features

- ✓ 25mhz Intel 80386 processor.
- ✓ 4 megabytes of zero wait-state RAM.
- ✓ 65 mb 22ms RLL hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive (2nd drive add \$79)
- ✓ Standard chassis with keylock, and speed and reset buttons. (Optional chassis add \$50)
- ✓ Monochrome monitor with monochrome graphic board.
- ✓ 200 watt power supply.
- ✓ Clock calendar, parallel port, and two serial ports.
- ✓ Keytronics 101 key enhanced keyboard.
- ✓ 8 expansion slots and 5 drive bays.
- ✓ Phoenix BIOS.
- ✓ FCC Class B approved.

The optimum combination of features, expandability, and power make the FastData 386/25 an ideal choice for those whose applications demand the most from a computer. Whether running as a network fileserver, CAD or graphics station, or power-user's workhorse, the FastData 386/25 handily meets the challenge. It comes configured with a whopping four megabytes of fast RAM, a superfast 22 millisecond 65 megabyte hard disk, and maximum VGA displaying 1024 by 768 resolution powered by a high-output 16 bit 512K VGA board. Plus, the FastMicro team will configure your FastData 386 exactly the way you want, without sending you shopping elsewhere. When evaluating 386-DX workstations, why even consider anything else?

System Price	65mb	80mb	100mb	200mb
Monochrome	\$1,819	\$1,969	\$2,069	\$2,469
VGA Color	\$2,149	\$2,299	\$2,399	\$2,799
VGA 1024	\$2,299	\$2,449	\$2,549	\$2,949



FastData 286/12

\$899

Standard Features

- ✓ 12mhz 80286 processor.
- ✓ 1 megabyte of zero wait-state RAM.
- ✓ 40 mb 28ms hard disk 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive (2nd drive add \$79).
- ✓ Standard chassis with keylock, and speed and reset buttons. (Optional chassis add \$50)
- ✓ 8 expansion slots and 5 drive bays.
- ✓ 200 watt power supply.
- ✓ Monochrome monitor with monochrome graphic board.
- ✓ Clock calendar, parallel port, and two serial ports.
- ✓ Keytronics 101 key enhanced keyboard.
- ✓ Phoenix BIOS.
- ✓ FCC Class B approved.

Imagine a fast 286 computer at a super price and you've got the FastData 286/12. This system is complete, not stripped. You get one megabyte of zero-wait-state memory and a 28ms IDE hard disk - standard. Also included is an amber monitor and graphics card, your choice of a high density 1.2mb or 1.44mb floppy drive and a Keytronics keyboard. And since it's a FastData, you are backed with toll-free technical support, one year warranty with the FastShip replacement program & on-site service plan, and our 30 day full money back satisfaction guarantee!

System Price	40mb	65mb	80mb	100mb
Monochrome	\$899	\$999	\$1,149	\$1,249
VGA Color	\$1,229	\$1,329	\$1,479	\$1,579
VGA 1024	\$1,379	\$1,479	\$1,629	\$1,729

Why FastData?

A personal computer is a large investment. Before you choose, we want you to know what to expect when you purchase a FastData personal computer from FastMicro.

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You get more out of your FastData personal computer because we put more into it. We've been building PC's longer than most of the competition and we put that experience to work for you. We use proven designs that pass our stringent performance requirements and compatibility standards so it will be sure to pass yours.



Better Components.

FastData systems use some of the best parts in the industry. For example, each FastData system ships with a Keytronics keyboard. Keytronics costs a bit more than others, but the quality is worth it. Standard equipment includes quality components from Toshiba Western Digital, Phoenix and other industry leaders.

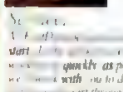
Selection.

Our face to face retail background has made us never forget that the customer comes first and that a personal computer is just part of a customer's overall needs. That's why FastMicro offers thousands of hardware and software products to enhance your new personal computer. In fact, our competition will probably tell you as much as when you need something to run on their personal computer.



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Our team is standing by and ready to make your FastData computer perform to its greatest potential for you. When you buy a FastData computer, you're covered by Toll-Free technical support for life. And since we sell more software than other computer companies, we are uniquely qualified to give the proper support the customer deserves.



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HARDWARE

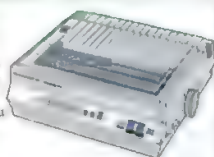
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Citizen	
200GX	189
GSX140	285
Diconix 150 Plus	329
Fujitsu	
DL3400	419
NEC	
P2200XE	309
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P5300	659
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Max15	237
Ultrasync 12"	479
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Samsung	Call
Seiko	
CM1440	519
CM1450	659
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Zenith 1492	Call

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2400 ETC External	187
VGA Wonder 512K	239
VGA Wonder +	Call
Brown Wagh Sound Blaster	157
Everex	
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2400B Int Modem	105
EGA 480 Card	79
RAM3000 16 bit RAM card	75
RAM8000 16 bit RAM card	169
Hercules Graphic Card +	169
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387-DX20	369
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Tiny Turbo 286	207
Tiny Turbo Xtra	267
Paradise	
Basic VGA - 8 bit	109
VGA 1024 256K	175
VGA 1024 512K	229

Practical Peripherals	
1200B Int Modem	59
2400B Int Modem	125
2400B Int with MNP	169
Prometheus	
Promodem 1200B Int.	48
Promodem 2400B Int.	98
Promodem 2400G Ext.	149
The Complete PC	
Answering Machine	239
Fax 4800	229
Hand Scanner 400	139
Tiara Networking	
Lancard/A PC (Arcnet)	79
Lancard/E Star 8 (Ethernet)	139
Lancard/E AT (16 bit Ethernet)	249

USRobotics	
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2400 Baud External	149
Courier HST 14,400 Ext.	579
Courier HST 14,400 Int	539
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VGA 1024i 256K	209
VGA 1024i 512K	237
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V-RAM VGA 512K	355

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WD1006V-MM2 MFM AT 1:1	89
WD1006V-SR2 RLL AT 1:1	99
WE1007V-SE2 ESDI AT 1:1	169

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Datashield 100	57
Datashield ST450 UPS (450VA)	319
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14" VGA 1024 x 768i 28 dp	399

FastData Boards

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CGA or MGP Card	35
Parallel Dual Serial/Game Card	35
XT 1.44 Dual Floppy Controller	35

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720K 3.5" Floppy	69
1.2MB 5.25" Floppy	79
1.44MB 3.5" Floppy	79

Toshiba 1.44 3.5" \$79 Floppy Drive

This drive formats and reads 720K and 1.44mb formats. Kit includes brackets and black and grey faceplates. Rush add \$5



SOFTWARE

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Clanor Prof. Developer	449
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dBase III+	439
dBase IV	479
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Foxbase Plus	177
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Generic Cadd Level 2 Starter Kit	109
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PC Paintbrush IV Plus	109
Perspective Jr.	69
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Works	89

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Quick Pascal	60

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Lucid 3-D	53
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Windows 3.0

\$89 This hot graphical environment runs even Windows software and breaks the 640K barrier. Buy Windows from FastMicro and we'll throw in 12 Windows shareware applications for free! Requires a 386 or above.



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Corel Draw (GR)	309
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Grammatik IV for Windows (WP)	49
PC Paintbrush for Windows (GR)	77
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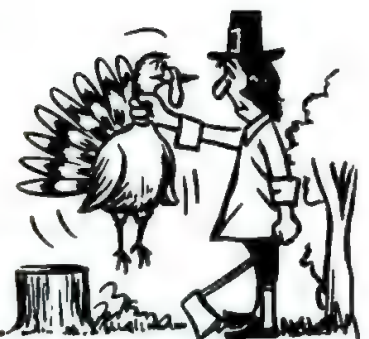
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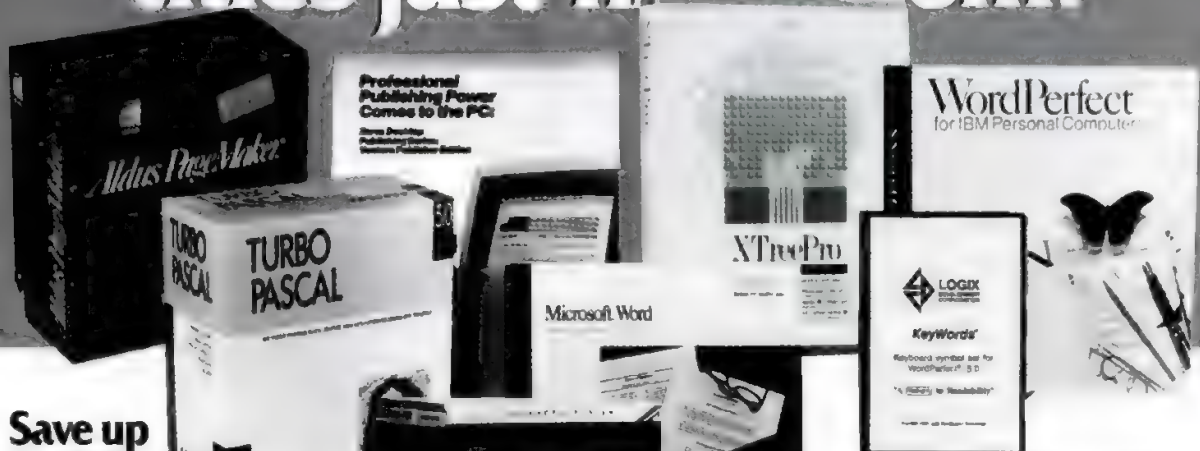
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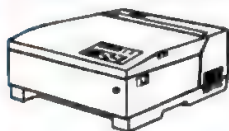
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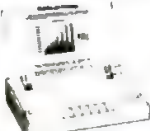


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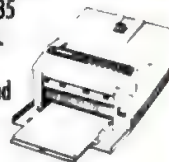
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14. ☐ Admin./Mgmt.
99. ☐ Other

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02. ☐ No5. For how many IBM PCs and
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02. 11-25
03. 26-99
04. 100 or more

6. Are there any PCs in your office?
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02. ☐ Linked to mini
03. ☐ Networked together

7. Please check the equipment
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(Check all that apply.)

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02. ☐ IBM or Compatible Mainframes
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04. ☐ Macintosh

8. Do you plan to buy any PC Products?

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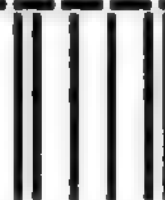
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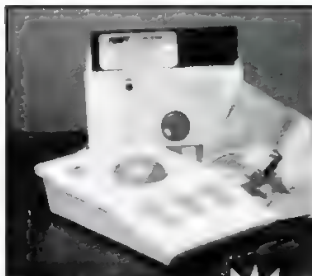
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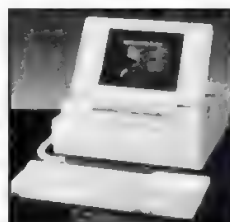
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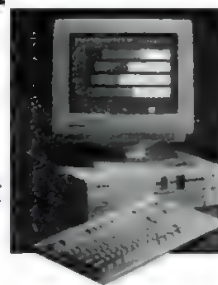
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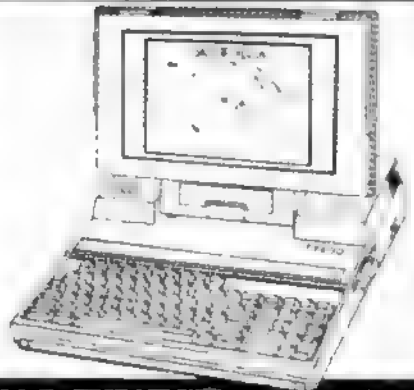
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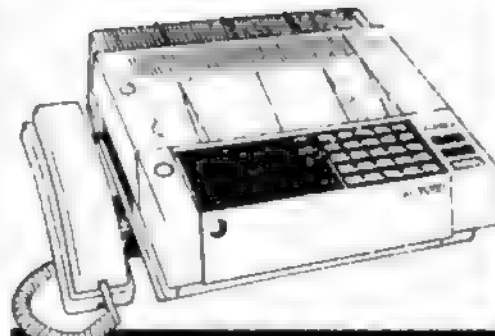
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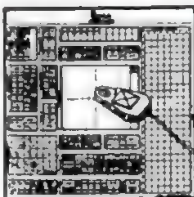
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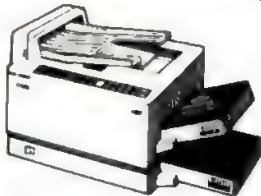
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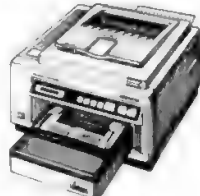


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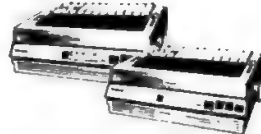
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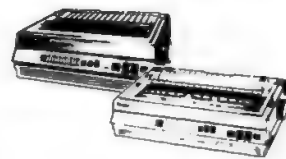
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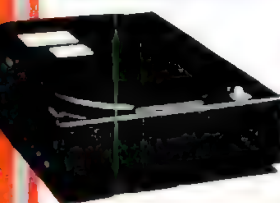
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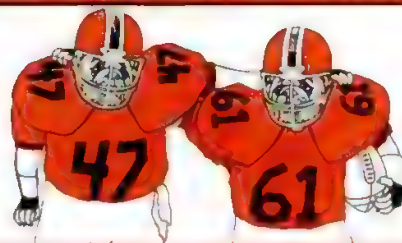
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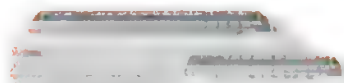
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NLQ: 110 CPS (15 CPI)
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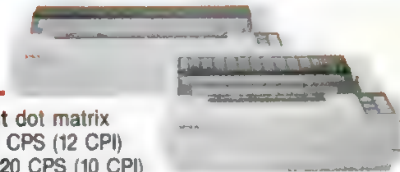
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LX 810

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Draft: 180 CPS (12 CPI)
150 CPS (10 CPI)
NLQ: 30 CPS (12 CPI)



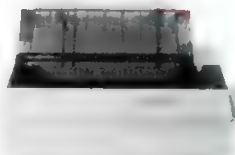
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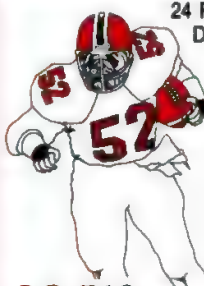
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24 Pin, impact dot matrix
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150 CPS (10 CPI)
NLQ: 60 CPS (12 CPI)
50 CPS (10 CPI)



LQ 510

24 Pin, impact dot matrix
Draft: 225 CPS (15 CPI)
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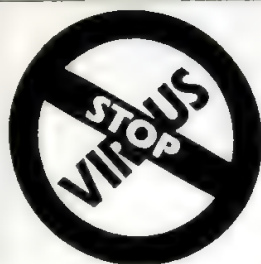


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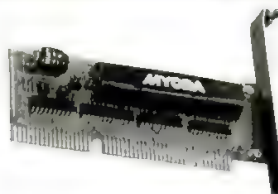


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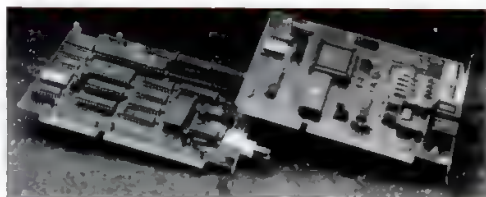
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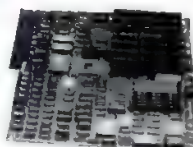
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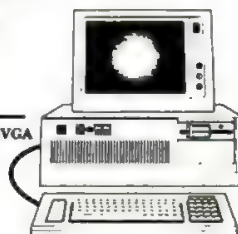
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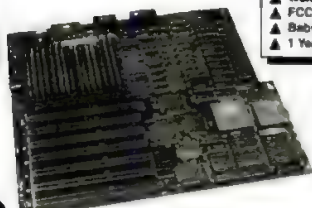
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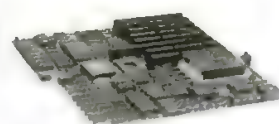
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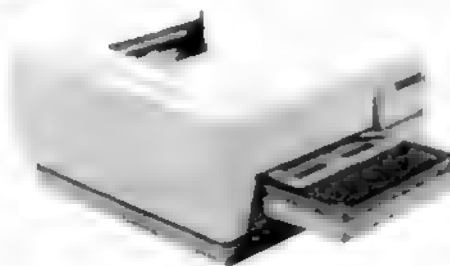
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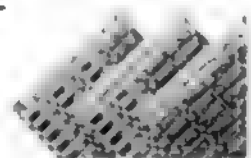
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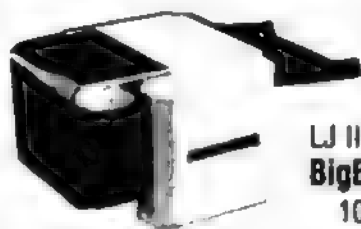
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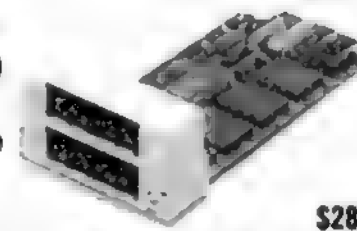
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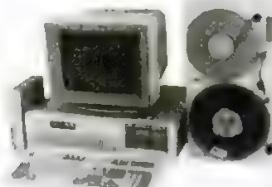
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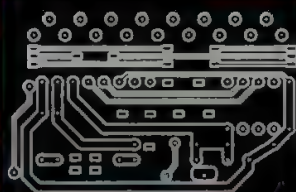
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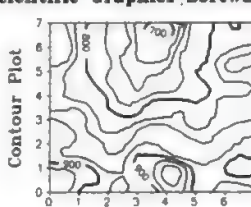
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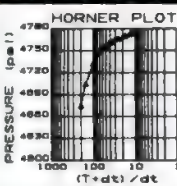
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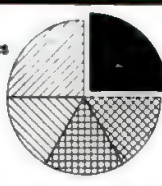
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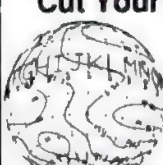
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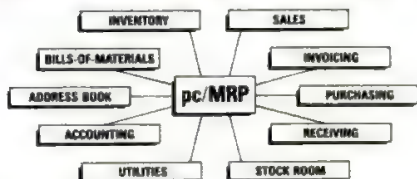
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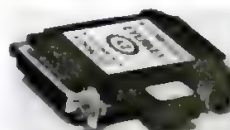
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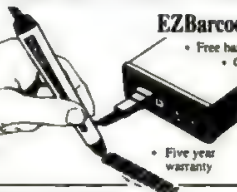
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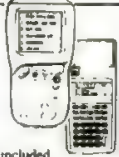
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COMING UP

■ PERSONAL INFORMATION MANAGERS

Is it really possible to automate your Rolodex, phone book, appointment schedule, and to-do list, and combine them into one powerful information management system? It definitely is, and the 14 PIMs that we evaluate (including four that demonstrate the advantages of managing your information in the *Windows* environment) prove it. Also included in this feature: a look at PIM-like packages you may already own.

■ UNINTERRUPTIBLE POWER SUPPLIES

Taking the mumbo-jumbo out of buying a UPS is not always an easy task. Insuring your network against blackouts, brownouts, power spikes, and surges is essential, but how much protection do you really need—and for how long? Here's how to make the job easier and back up your LAN without getting taken for a ride. PC LAN Labs puts 25 uninterruptible power supplies to the test.

■ 20-MHz 386SX PCs

Poised between 16-MHz 386SXs and 20-MHz 386 PCs, the new breed of 20-MHz 386SXs promises more speed and plenty of options. With competitive pricing and assurances of fast performance, these computers could become the new favorite for entry-level computing. Vendors have quickly jumped on this bandwagon; within months of Intel's introduction of the 80386SX/20 chip, 38 manufacturers were able to send PC Labs working, production models. Here, we take a look at them all.

■ HIGH-END E-MAIL

Electronic mail tops the list of our readers' favorite LAN applications. The LAN Labs crew examines high-end e-mail packages able to carry the mail in large organizations. *Lotus Notes*, *IBM OfficeVision*, and other new high-investment products create news while *cc:Mail*, *Network Courier*, *Higgins*, and 18 other products create sales.



PC MAGAZINE ADVERTISING SALES STAFF

One Park Avenue, New York, N.Y. 10016
(212) 503-5100

Director of Sales - Telemarketing - Nancy Newman
Telemarketing Manager - MaryJo Boudinot

Senior Advertising Coordinator - Allyson Dubin
Advertising Coordinator - Christine Holsten
Asst. Advertising Coordinator - Lynette Stiffa

Al Di Guido - Eastern Advertising Manager (212) 503-5310

MA, NH, VT, ME, RI

Sloan Seymour - District Manager
(617) 497-2632
4 Cambridge Center
Kendall Square
Cambridge, MA 02141
Todd Anderman - Account Representative
(212) 503-5132

CT, NY, NJ, PA

Michael Bird - District Sales Representative
(212) 503-5307
Lisa Friedman - District Sales Representative
(212) 503-5149
Peter C. Weedfald - District Manager
(212) 503-5269
One Park Avenue
New York, NY 10016
Joyce Wasserman - Account Representative
(212) 503-5333
Stephanie Brzozowski - Account Representative
(212) 503-5675

DE, MD, DC, VA, WV, NC, SC, AL, MS, TN, AR, KY, GA, FL

Scott J. Seltz - District Manager
Mark Crafts - District Sales Representative
3405 Piedmont Road
Atlanta, GA 30305
(404) 239-9780
John Despirito - Account Representative
(212) 503-5130

Robert Dittler - Central Advertising Manager (312) 346-7666

NE, WI, IL, IN, KS, MN, MO, OH, MI, IA, ND, SD, Canada

Stephen Dress - District Manager
Jay Overbye - District Sales Representative
150 North Wacker Drive
25th floor
Chicago, IL 60606
(312) 346-7666
Maureen Dooley - Account Representative
(212) 503-5126
Chris Sullivan - Account Representative
(212) 503-5047

TX, OK, LA, UT

Sandy Schackman - District Manager
5956 Sherry Lane Suite 625
Dallas, TX 75225
(214) 691-6934
Karen Keavey - Account Representative
(212) 503-5104

Pamela Rock - Western Advertising Manager (415) 378-5525

CA (San Francisco & North), ID, OR, WA

Mike Kisseberth - District Manager
(415) 378-5527
Rick Vandervoorn - District Sales Representative
110 Marsh Drive, Suite 103
Foster City, CA 94404
(415) 378-5520
Deborah Gattton - Account Representative
(212) 503-5129

CA (Santa Barbara to So. San Francisco), WY, MT, AK, CO, UT

Pete Foster - District Manager
Kim Dawson - District Manager
110 Marsh Drive, Suite 103
Foster City, CA 94404
(415) 378-5528

CA (San Diego & Orange County), AZ, NV, HI

Robin Kofsky - District Sales Representative
David Lynn - District Sales Representative
18500 Von Karman Ave. Suite 510
Irvine, CA 92715
(714) 852-8001
Michael Hatherill - Account Representative
(212) 503-5113

CA (Los Angeles)

Mary Ariotto - District Manager
Paul Klein - District Sales Representative
3530 Wilshire Blvd.
Suite 645
Los Angeles, CA 90010
(213) 387-2100
Beth Gartenberg - Sr. Account Representative
(212) 503-5040

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After Hours

Products for the Leisure Side of Personal Computing

Ballade Sequencer Uses Graphical Interface to Tame Roland Synthesizers



The Roland MT-32 MIDI synthesizer module and its siblings, the CM-32L sound module and the LAPC-I sound card, are popular because they combine great sound, multitimbral capability and low price. *Ballade*, from Dynaware, is a low-cost (\$195) 10-track music sequencer and sound editor/librarian pro-

gram that automatically moves each note so it starts right on the nearest eighth note, sixteenth, or other even division of the beat. (Oddly, quantizing to triplets is not available, except 64th-note triplets!) Those with limited keyboard skills can use the Step Recorder to record notes and chords one at a time.

Each track can be displayed on the Song screen using the notes, beams, and staves of stan-

ards, and rhythmic offset (moving notes slightly ahead or behind the beat). Notes can be entered or edited by selecting from the Palets with a mouse, and then clicking on the screen, in a manner similar to many paint programs.

Sections of tracks can be cut and pasted by highlighting a region and selecting commands from pull-down menus. The display can zoom out to show several measures, or zoom in to concentrate on a few beats. It's fun to watch the screen scroll through the track as the music plays; the scrolling can be turned off for complicated music or a slower computer.

Ballade reserves Track 1 for an external keyboard. Tracks 2 through 9 are for eight different MT-32 synthesizer timbres, and track 10 is for the MT-32's drum and special effect sounds. Tracks 2 through 10 are "hard-wired" to their corresponding MIDI channels. Track 1, however, can be set to any MIDI channel, and can "re-channelize" the MIDI from a keyboard to any other MIDI channel. This is helpful if you have a Roland PC-100 or an old Yamaha DX7 keyboard, both of which only send data on MIDI channel 1.

For track 10 (the drum track), a special version of the Song screen, with a grid display, shows the percussion instruments by name. The drum track works with the extra percussion and special effects available on the LAPC-I and CM-32L, such as helicopters, thunder, and laser guns.

Ballade's Play screen combines the familiar recording studio interfaces of a tape deck and a mixing board. Each track has a volume fader, a level meter, a pan pot for panning the track in the stereo field, buttons for muting and adding reverb, and a patch number display. There is a master volume fader, master



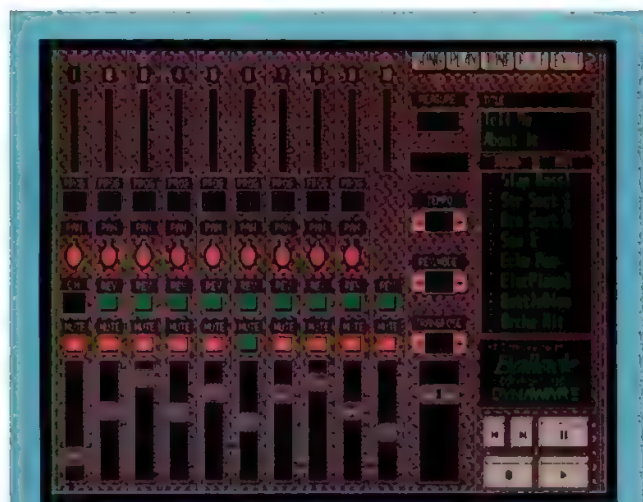
reverb level, and controls for changing tempo and pitch transposition.

All of these controls may be adjusted with the mouse as the music plays. With the level meters dancing to your tune, you can fade in tracks, mute them, or pan them from side to side. You hear the results in real time, just as if you were using a real mixing board. You can then make an automated mix, so that faders move up and down on the mixing board, and pan pots and patches change before your eyes.

Makers of state-of-the-art mixing consoles need not fear competition quite yet, because, unfortunately, *Ballade* can't generate the automated mix by recording "moves" on the mixing board. Instead, you select an area from the Song screen, choose starting and ending levels, and pick a straight line or exponential curve. This curve can control a volume fader, tempo, or other parameters. This procedure is fine for some controllers, like pitch bend, but is much less spontaneous than sliding a fader and using your ear.

The Tone screen is an editor/librarian for the MT-32 family. All the tone parameters are displayed and ready for tweaking. Besides the basics of choosing

CONTINUES



Ballade's elegant, colorful Play screen combines a completely automated mixing board with familiar, tape deck-style controls.

gram that uses striking color graphics to exploit the capabilities of these synthesizers.

Recording tracks on *Ballade* is straightforward. You can start or end at the beginning of any measure (with a two measure count-off if desired). Cowbell and hi-hat drum sounds from the MT-32 are used as a metronome—much easier on the ears than computer beeps! If your rhythm is not steady, your track can be quantized, which auto-

matically moves each note so it starts right on the nearest eighth note, sixteenth, or other even division of the beat. (Oddly, quantizing to triplets is not available, except 64th-note triplets!) Those with limited keyboard skills can use the Step Recorder to record notes and chords one at a time.

Each track can be displayed on the Song screen using the notes, beams, and staves of stan-

After Hours

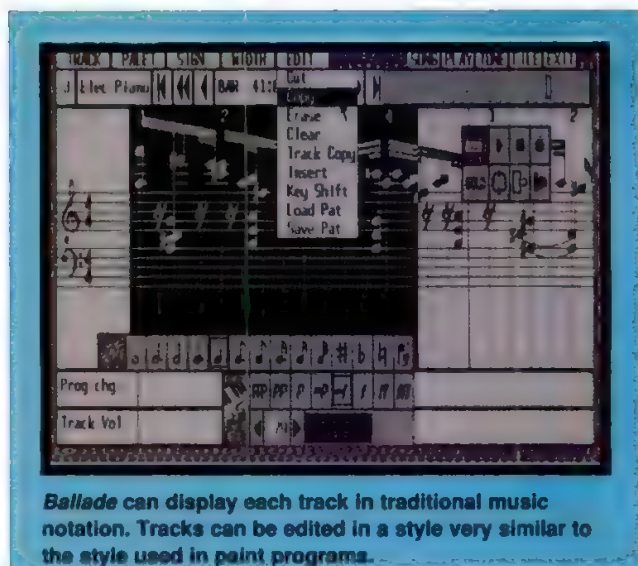
Dynaware

CONTINUED

waveforms and samples, you can use the mouse to draw envelopes that control a low-pass filter and the volume of each waveform, and even determine the width of pulse waves.

As the manual mentions, *Ballade* can run on any 640K PC, but it really needs a 286 or 386 machine to run efficiently. Besides the demands made by the intensive graphics, it can take a lot of processing time to transcribe a new track into musical notation. Using a 286 AT clone, I recorded a complicated 16-bar piano solo, and then had to wait 60 seconds for *Ballade* to process the track. Single lines and simpler parts were processed much more quickly, however.

Ballade is so good in some ways that I kept wanting addi-



Ballade can display each track in traditional music notation. Tracks can be edited in a style very similar to the style used in paint programs.

tional features to really fulfill its promise. In particular, the mixing board on the Play screen is so visually intuitive that it would make an ideal interface for recording a mixdown. Without this recording capability, the mixing board is fun, but less

musically useful. Also, the drum track grid would really be complemented by drum machine-style loop recording, or at least an easier way to record overdubs. Presently, you have to record on a separate track, then bounce tracks together.

Those who have several synthesizers will probably want a more general sequencing program, and may feel limited in particular by having only 10 tracks. However, it is possible to bounce tracks, and many music hobbyists will find 10 tracks to be plenty. Dynaware says that Version 2.0 will print out music and accept standard MIDI sequence files. If you have a fast computer, a member of the MT-32 synthesizer family, and a MIDI keyboard, you can have lots of fun with *Ballade*.

List Price: *Ballade*, Version 1.6, \$195. **Requires:** 640K RAM; DOS 2.1, 3.1, 3.2, or 3.3; EGA or VGA graphics; mouse; Roland LAPC-I card, Roland MT-32 or CM-32L MIDI Sound Module with MPU-401 or compatible interface; MIDI keyboard (optional); hard disk recommended. Dynaware USA Inc., 950 Tower Ln., #1150, Foster City, CA 94404; (415) 349-5700.

CIRCLE 548 ON READER SERVICE CARD

Master Tracks Pro Brings Its Power to MS-Windows

Passport Designs' powerful sequencer, *Master Tracks Pro*, has served Macintosh musicians admirably for years. Now it has found a home under the Windows environment, sporting enough features to give the best PC sequencers a run for their money.

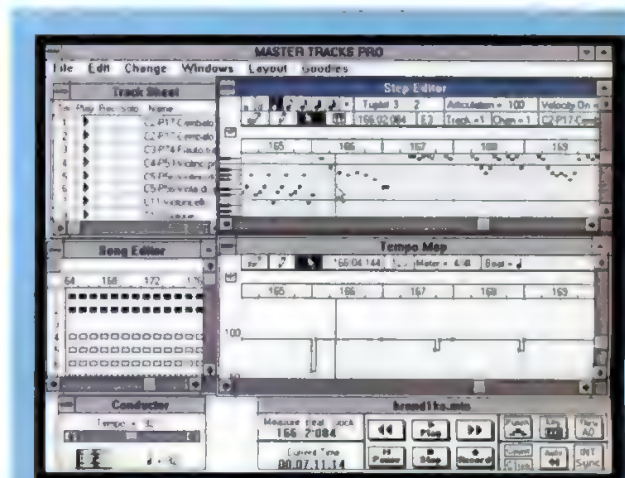
Its superb use of the graphical user interface makes *Master Tracks Pro* a real standout product. The package offers a wealth of graphical views of your music, and lets you view different aspects of your music simultaneously in multiple windows. You can move and size the windows during playback, and they all scroll to follow the music. If you become attached to a particular window arrangement, you can save it as a start-up default. One window shows all tracks together, with each measure depicted as a small box.

This allows easy cuts-and-pastes, even of huge multitrack sections. Another window holds

the piano-roll-style note editor, and presents a graphic representation of the note pitches and durations, along with a set of toolbox icons. To delete material, you simply select the eraser tool and click on the notes you want to delete. With the pencil, you can insert notes or drag them to new locations. Just click on the icon of the note value you want to insert. The note editor also accepts notes one at a time from your MIDI keyboard instead of your mouse.

One of *Master Tracks Pro*'s few weak spots becomes apparent when you edit single notes. The notes are so small that it takes a real deadeye to position the cursor on them. When you try to click on a note in order to move it, it's all too easy to miss and insert a new note instead. Once you've grabbed a note, repositioning it precisely on a beat is also tricky. Fortunately, double-clicking on a note lets you edit its parameters numerically for exact positioning.

When it comes to editing



Master Tracks Pro lets you view different aspects of your music simultaneously in different windows.

controller events, *Master Tracks Pro* reminds us why we love graphical interfaces so much. The program presents you with a graph of pitch bend, aftertouch, or any other controller in a track. Each event appears as a point or bar on the graph. Drawing a curve with the mouse scales controller changes over a portion of music, or you can add or thin out events one by one. Another window graphs tempo changes in a similar fashion.

You can position a controller window and the piano-roll screen one above the other and use a six-level zoom on both of them simultaneously.

These graphic goodies aren't a substitute for global event editing. Dialog boxes give you global control over tempo and controllers, as well as pitch, duration, note-on positions, and key velocity. By scaling values, you can create smooth crescendos.

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After Hours

Passport

CONTINUED

dos and decrescendos or accelerandos and ritards. You can increase or decrease all values by a fixed amount or a percentage and even convert one controller type to another.

The quantize feature tackles rhythmic carelessness by letting you shift note attacks or entire notes to the nearest specified portion of the beat during editing or recording. If you rush a passage a little, specifying the percentage ahead of the beat when quantizing will occur can ensure that notes are not shifted in the wrong direction. To keep the rhythm from sounding too wooden, you can adjust the percentage of quantization.

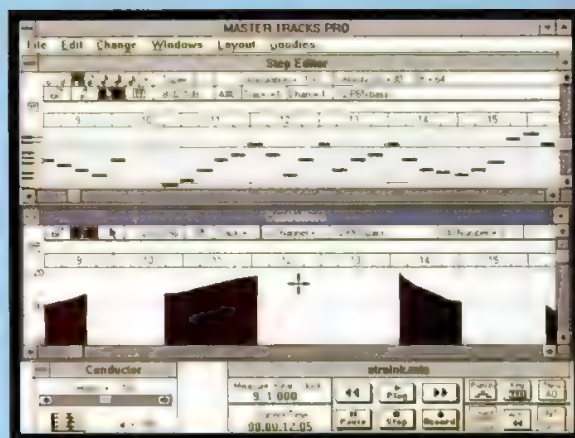
Recognizing that computer precision can be an enemy of creative musical expression, Passport has included a unique "humanize" feature. This adds random variations within a specified range to note-on positions, durations, or key velocity. Mu-

sical expression may be incompatible with neat mathematical values, but it isn't a random process, either. Humanized sequences tend to sound more like sloppy musicianship than expressive playing.

Master Tracks Pro's recording and playback features are flexible and powerful. The software offers a precise resolution of 240 clock ticks per quarter note and 64 tracks to record on. You can assign playback and record functions to keys of your MIDI keyboard. There's also support for SMPTE and MIDI time codes.

The program lacks a few things, such as an index for the manual, a way to list and edit all MIDI events on a track, and a way to adjust the balance of tracks during playback. We also encountered bugs when importing MIDI files and uploading system-exclusive data, but the publisher provided fixes that will go into the program's next interim release.

By the time you read this, *Master Tracks Pro* should fully support *Windows 3.0*. This will let you load gigantic sequences



Master Tracks Pro's controller window lets you draw curves with the mouse to create smooth controller changes.

into *Win 3's* vast stretches of memory, but otherwise the sequencer's features will remain the same. The *Windows 3.0* version will bear the same price tag as the version reviewed here, with upgrades available for \$45. If you want the excellent interface but don't need all the powerhouse features, Passport offers a scaled-down version called *Trax* for \$99.95.

List Price: *Master Tracks Pro*, \$395. **Requires:** DOS 3.1, 640K RAM, *Windows 2.11* or higher (*Windows* runtime included), mouse, graphics adapter, Roland MPU-401 or compatible MIDI interface, MIDI keyboard; hard disk recommended. Passport Designs, 625 Miramontes St., Half Moon Bay, CA 94019; (415) 726-0280.

CIRCLE 540 ON READER SERVICE CARD

MIDI Records: "Piano Rolls" For Your Synthesizer

MUSIC
by Rob Kendall

Just as graphics software packages spawned a thriving clip-art industry, it was inevitable that the booming market in sequencers would inspire libraries of songs on disk.

On the surface, this "clip-music" seems similar to the rolls that were once used to drive player pianos. You simply load a sequence into your favorite sequencing software, and it tells your synth what to play and when to play it. But *Midi Records* improves on piano rolls as much as synthesizers improve on player pianos.

Music Data Co. puts professional-caliber performances at your fingertips with a sequence library that's over 300 titles strong and growing. *MIDI Records* is both a ready source of instrumental backup for pros and a

valuable learning resource for students.

The library spans a wide gamut of styles that encompass pop chart-busters of the '50s to the '80s, as well as country, big-band jazz, and some very ambitious classical offerings. Included are four complete *Brandenburg Concertos* of Bach and all of Vivaldi's *The Four Seasons*.

You can order songs individually from the *MIDI Records* catalog for \$19.95 each, with the longer classical pieces costing more. Selections from the library are also available in a 12-volume *MIDI Hits* series; each \$39.95 volume contains three songs.

The sequences come in Type 1 Standard MIDI format, which most sequencers can import. Channel and program assignments are designed for the Roland MT-32 synthesizer, so if you have this or a compatible

unit, you can play the sequences right out of the box.

With other synthesizer models, you'll have to experiment with the instrumentation and balance of the tracks to get the right sound. The instrumentation is carefully spelled out in the track names, which helps. The drum track will work with most Roland-compatible drum machines.

The selections we sampled from each stylistic category were consistently impressive. All are obviously the product of musicians steeped in the style of the particular piece.

Where appropriate, the sequences feature rich harmonizations and accomplished solos, making good use of the varied instrumental resources of the MT-32. The sequences use dynamic gradations and pitch bend to good affect, but many would gain some warmth from vibrato controllers, which are absent.

Bach's 15 Two-Part Inventions are sensitively rendered

with correct ornamentation. To achieve the subtle inflections of tempo necessary for phrasing, these sequences use skillfully inserted tempo changes which keep the notes properly aligned with the bar lines. The *Fifth Brandenburg Concerto* receives a respectable performance, though the limits of synthesized sound aren't very amenable to orchestral music.

MIDI Records aren't cheap, but the serious musician will find them worth the price. They fully realize MIDI's potential, and serve as models of what can be done with relatively inexpensive, modern music synthesis equipment.

List Price: *MIDI Records*, \$19.95 per sequence. Also available in three-sequence volumes of the *MIDI Hits* series, for \$39.95 per volume.

Requires: Compatible MIDI sequencer, MIDI interface and synthesizer. Music Data Co., 625 Miramontes St., Half Moon Bay, CA 94019; (800) 443-3210.

CIRCLE 550 ON READER SERVICE CARD

After Hours

PC Music Maker: MIDI for Beginners



Getting started with MIDI sequencing can be intimidating for the uninitiated. To help make the plunge painless, Eclipse Technologies provides all you need in one package called the *PC Music Maker Home Recording Studio*. The *PC Music Maker* comes with a MIDI interface box, two MIDI cables, a low-end sequencer package called *Maestro*, and even a tutorial video-tape on MIDI and sequencing basics.

The HRS-3000 Studio Box interface should appeal to people who don't like opening up the computer or who want to sequence from a laptop with no expansion slots. The interface plugs into the PC's parallel port, and gives you three MIDI Out connectors and three MIDI Ins.

During recording, you can switch via the software among three synthesizers hooked up to the MIDI In connectors.

The interface isn't Roland MPU-401-compatible, and no third-party MIDI software supports it. *Maestro*, the included software, does support the Roland MPU-401 and the CMS 104 interfaces, however. In fact, it has the unique capability of controlling up to six different MIDI interfaces at one time for a total of 64 simultaneous channels in and out. The software lets you lay down 64 tracks and has bare-bones versions of most features you'd expect in a sequencer. You can punch in and out, transpose, quantize, and filter or edit controllers.

The piano-roll-style note editor displays all tracks simultaneously, with each track represented by a different color.

For viewing and editing simple music, this is more convenient than switching from screen to screen to see different tracks, as required by most sequencers. The *Maestro* screen can get pretty cluttered, though, if you accumulate a lot of tracks.

Another novel feature saves you from constantly looking up the program numbers of the instrumental timbres on your keyboard. You simply put the instrument names and their numbers in an ASCII file; then when you're assigning programs to tracks, you just type in the file-name and the first few letters of the instrument name and the sequencer does the rest.

In other areas the software cuts too many corners to make it easy to use. It won't divide your music into bars. Instead it just shows the total number of beats accumulated. What should be simple editing functions can turn into convoluted procedures. Inserting a few bars involves copying music onto new tracks, erasing the original material, and then copying the music back to a new position.

It takes too many keystrokes to move from one function to another, and the keystrokes required are often unintuitive and inconsistent. It's also a nuisance to type in beat numbers for each section you want to play back or edit. A lack of on-line help and an unindexed manual don't make things any easier.

The *Home Recording Studio* has some strong attractions for the beginning MIDI musician, including ease of installation and a low price. To advance beyond dabbling requires a struggle with the software's weaknesses. In terms of user interface and editing features, it falls short of the standard set for inexpensive sequencers by programs such as Twelve Tone Systems' *Cakewalk* or Voyetra's *Sequencer Plus Mark I*.

List Price: *PC Music Maker*

Home Recording Studio, \$269.

Requires: 256K RAM, DOS 2.1 or higher, parallel port, MIDI keyboard. Eclipse Technologies Inc., 1221 W. Campbell Rd., #125, Richardson, TX 75080; (214) 238-9944.

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CIRCLE 137 ON READER SERVICE CARD

Abort, Retry, Fail?

The Lighter Side of Personal Computing

Very Similar

"However, if you are considering an AT-compatible, PS/2, or 80386-based machine, you will be given the option of purchasing PC- or MS-DOS (DOS stands for Disk Operating System) 3.3 or 4.0 or OS/2. These operating systems are very similar."

—USAir magazine, February 1990

But That's okay— DOS and OS/2 Are So Similar

"Furnished with enough memory and a hard disk, most ATs can run OS/2. Some older ATs may be equipped with 8086 chips, which are not capable of running OS/2."

—USAir magazine, February 1990

Imagine the Tricks a Novice Intermediate Could Perform

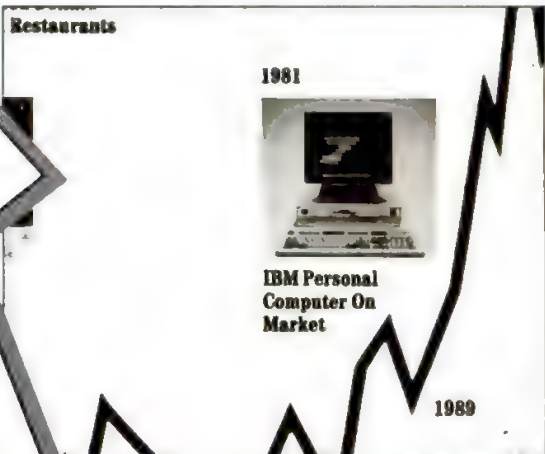
"A historic file [in ViewPlan's estate planning software] keeps past events for review. A perpetual calendar shows three months at once. The data file is simple enough that any advanced novice can, with a bit of editing, move in dates or data from an older system."

—CPA Micro Report, December, 1989

Reasonable Solutions of Medford, Oregon, distributes "user supported" software disks cheaply, but you'll pay about twice as much per disk if the offer comes on a card printed in red rather than blue. "User-supported" means if you use the software, you're expected to pay for it.



Back to the future: The IBM PC was introduced in 1981, but it wasn't until 1987 that an IBM PC looked like the one in the timeline for Shearson Lehman Hutton's SLH 1990s Fund.



If your entry is used in Abort, Retry, Fail? we'll send you \$50 and a PC Magazine T-shirt. Caution: In case of multiple entries, the postmark date, neatness and completeness of entry are considered. Winners this issue: Sandro Appetiti (DOS and OS/2: very similar), Donald Palomaki (8086 chips), Vern Garvelink (advanced novice), Scott Simmons (Reasonable Solutions), David S. Smith (1981 PS/2).

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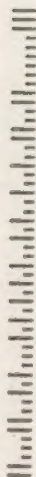


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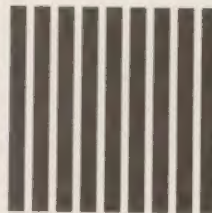
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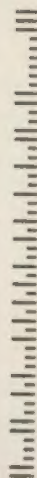


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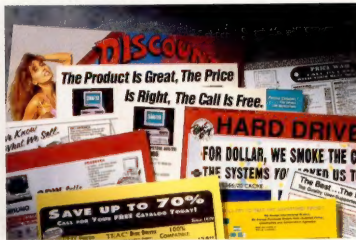
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